Workshop Manual

Power Trim and mounting collar

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Aquamatic 270T

Workshop Manual

Power Trim and mounting collar Aquamatic 270T

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Safety Precautions

Introduction

This Workshop Manual contains technical data, descriptions and repair instructions for Volvo Penta products or product versions contained in the contents list. Ensure that the correct workshop literature is being used.

Read the safety information and the Workshop Manual "General Information" and "Repair Instructions" carefully before starting work.

Important

In this book and on the engine you will find the following special warning symbols.

WARNING! If these instructions are not followed there is a danger of personal injury, extensive damage to the product or serious mechanical malfunction.

IMPORTANT! Used to draw your attention to something that can cause damage, product malfunction or damage to property.

NOTE! Used to draw your attention to important information that will facilitate work or operations.

Below is a summary of the risks and safety precautions you should always observe or carry out when operating or servicing the engine.

Immobilize the engine by turning off the power supply to the engine at the main switch (switches) and lock it (them) in the OFF position before starting work. Set up a warning notice at the engine control point or helm.

Generally, all servicing should be carried out with the engine switched off. Some work (carrying out certain adjustments for example) requires the engine to be running. Approaching a running engine is dangerous. Loose clothing or long hair can fasten in rotating parts and cause serious personal injury.
If working in proximity to a running engine, careless movements or a dropped tool can result in personal injury. Avoid burns. Take precautions to avoid hot surfaces (exhausts, turbochargers, charge air pipes and starter elements etc.) and liquids in supply lines and hoses when the engine is running or has been turned off immediately prior to starting work on it. Reinstall all protective parts removed during service operations before starting the engine.

Check that the warning or information decals on the product are always clearly visible. Replace decals that have been damaged or painted over.

Engine with turbocharger: Never start the engine without installing the air cleaner (ACL). The rotating compressor in the Turbo can cause serious personal injury. Foreign objects entering the intake ducts can also cause mechanical damage.

Never use start spray or similar to start the engine. The starter element may cause an explosion in the inlet manifold. Danger of personal injury.

Avoid opening the filler cap for engine coolant system (freshwater cooled engines) when the engine is still hot. Steam or hot coolant can spray out. Open the coolant filler cap carefully and slowly to release pressure before removing the cap completely. Take great care if a cock, plug or engine coolant line must be removed from a hot engine. It is difficult to anticipate in which direction steam or hot coolant can spray out.

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed, otherwise oil could be ejected.

Stop the engine and close the sea cock before carrying out operations on the engine cooling system.

Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that exhaust gases and crankcase ventilation emissions are ventilated out of the working area.

⚠ Always use protective goggles where there is a danger of pieces of metal, sparks from grinding, acid or other chemicals being thrown into your eyes. Your eyes are very sensitive, injury can lead to loss of sight!

⚠ Avoid skin contact with oil. Long-term or repeated contact with oil can remove the natural oils from your skin. The result can be irritation, dry skin, eczema and other skin problems. Used oil is more dangerous to health than new oil. Use protective gloves and avoid using oil-soaked clothes and rags. Wash regularly, especially before meals. Use the correct barrier cream to prevent dry skin and to make cleaning your skin easier.

⚠ Most chemicals used in products (engine and transmission oils, glycol, petrol and diesel oil) and workshop chemicals (solvents and paints) are hazardous to health Read the instructions on the product packaging carefully! Always follow safety instructions (using breathing apparatus, protective goggles and gloves for example). Ensure that other personnel are not unwittingly exposed to hazardous substances (by breathing them in for example). Ensure that ventilation is good. Handle used and excess chemicals according to instructions.

⚠ Be extremely careful when tracing leaks in the fuel system and testing fuel injection nozzles. Use protective goggles! The jet ejected from a fuel injection nozzle is under very high pressure, it can penetrate body tissue and cause serious injury There is a danger of blood poisoning.

⚠ All fuels and many chemicals are inflammable. Ensure that a naked flame or sparks cannot ignite fuel or chemicals. Combined with air in certain ratios, petrol, some solvents and hydrogen from batteries are easily inflammable and explosive. Smoking is prohibited! Ensure that ventilation is good and that the necessary safety precautions have been taken before carrying out welding or grinding work. Always have a fire extinguisher to hand in the workplace.

⚠ Store oil and fuel-soaked rags and fuel and oil filters safely. In certain conditions oil-soaked rags can spontaneously ignite. Used fuel and oil filters are environmentally dangerous waste and must be deposited at an approved site for destruction together with used lubricating oil, contaminated fuel, paint remnants, solvent, degreasing agents and waste from washing parts.

⚠ Never allow a naked flame or electric sparks near the batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which when mixed with air can form an explosive gas – oxyhydrogen. This gas is easily ignited and highly volatile. Incorrect connection of the battery can cause a spark which is sufficient to cause an explosion with resulting damage. Do not disturb battery connections when starting the engine (spark risk) and do not lean over batteries.

⚠ Never mix up the positive and negative battery terminals when installing. Incorrect installation can result in serious damage to electrical equipment. Refer to wiring diagrams.

⚠ Always use protective goggles when charging and handling batteries. The battery electrolyte contains extremely corrosive sulfuric acid. If this comes into contact with the skin, wash immediately with soap and plenty of water. If battery acid comes into contact with the eyes, immediately flush with copious amounts of water and obtain medical assistance.

⚠ Turn off the engine and turn off power at main switch(es) before carrying out work on the electrical system.

⚠ Clutch adjustments must be carried out with the engine turned off.

⚠ Use the lifting eyes mounted on the engine/reverse gear when lifting the drive unit.
Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed).

To ensure safe handling and to avoid damaging engine components on top of the engine, use a lifting beam to raise the engine. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine.

If extra equipment is installed on the engine altering its center of gravity, a special lifting device is required to achieve the correct balance for safe handling.

Never carry out work on an engine suspended on a hoist.

⚠ Never remove heavy components alone, even where secure lifting equipment such as secured blocks are being used. Even where lifting equipment is being used it is best to carry out the work with two people; one to operate the lifting equipment and the other to ensure that components are not trapped and damaged when being lifted.
When working on-board ensure that there is sufficient space to remove components without danger of injury or damage.

⚠ Components in the electrical system, ignition system (gasoline engines) and fuel system on Volvo Penta products are designed and constructed to minimize the risk of fire and explosion. The engine must not be run in areas where there are explosive materials.

⚠ Always use fuels recommended by Volvo Penta. Refer to the Instruction Book. The use of lower quality fuels can damage the engine. On a diesel engine poor quality fuel can cause the control rod to seize and the engine to overrev with the resulting risk of damage to the engine and personal injury. Poor fuel quality can also lead to higher maintenance costs.

General information

About the workshop manual

This workshop manual contains technical specification, descriptions and instructions for repairing Power Trim and mounting collar on 270T. For only the outboard drive model 270T the workshop manual for the 270B, C, D, applies.The product designation and number should be given in all correspondence about the product.

This Workshop Manual has been developed primarily for Volvo Penta service workshops and qualified personnel. Persons using this book are assumed to have a grounding in marine drive systems and be able to carry out related mechanical and electrical work.

Volvo Penta is continuously developing their products. We therefore reserve the right to make changes. All the information contained in this book is based on product data available at the time of going to print. Any essential changes or modifications introduced into production or updated or revised service methods introduced after the date of publication will be provided in the form of Service Bulletins.

Replacement parts

Replacement parts for electrical and fuel systems are subject to statutory requirements (US Coast Guard Safety Regulations for example). Volvo Penta Genuine parts meet these requirements. Any type of damage which results from the use of non-original Volvo Penta replacement parts for the product will not be covered under any warranty provided by Volvo Penta.

Repair instructions

The working methods described in the Service Manual apply to work carried out in a workshop. The engine has been removed from the boat and is installed in an engine fixture. Unless otherwise stated reconditioning work which can be carried out with the engine in place follows the same working method.

Warning symbols occurring in the Workshop Manual (for their meaning see *Safety information*)

WARNING!

IMPORTANT!

NOTE!

are not in any way comprehensive since it is impossible to predict every circumstance under which service work or repairs may be carried out. For this reason we can only highlight the risks that can arise when work is carried out incorrectly in a well-equipped workshop using working methods and tools developed by us.

All procedures for which there are Volvo Penta special tools in this Workshop Manual are carried out using these. Special tools are developed to rationalize working methods and make procedures as safe as possible. It is therefore the responsibility of any person using tools or working methods other than the ones recommended by us to ensure that there is no danger of injury, damage or malfunction resulting from these.

In some cases there may be special safety precautions and instructions for the use of tools and chemicals contained in this Workshop Manual. These special instructions should always be followed if there are no separate instructions in the Workshop Manual.

Certain elementary precautions and common sense can prevent most risks arising. A clean workplace and engine eliminates much of the danger of injury and malfunction.

It is of the greatest importance that no dirt or foreign particles get into the fuel system, lubrication system, intake system, turbocharger, bearings and seals when they are being worked on. The result can be malfunction or a shorter operational life.

Our joint responsibility

Each engine consists of many connected systems and components. If a component deviates from its technical specification the environmental impact of an otherwise good engine may be increased significantly. It is therefore vital that wear tolerances are maintained, that systems that can be adjusted are adjusted properly and that Volvo Penta Genuine Parts as used. The engine Maintenance Schedule must be followed.

Some systems, such as the components in the fuel system, require special expertise and special testing equipment for service and maintenance. Some components are sealed at the factory for environmental reasons. No work should be carried out on sealed components except by authorized personnel.

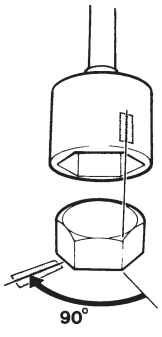
Bear in mind that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for cleaning engine components, unless otherwise stated in a workshop manual. Take special care when working on-board, that oil and waste is taken for destruction and is not accidentally pumped into the environment with bilge water.

Tightening torques

Tightening torques for vital joints that must be tightened with a torque wrench are listed in workshop manual “Technical Data”: “Tightening Torques” and are contained in work descriptions in this Manual. All torques apply for cleaned threads, screw heads and mating surfaces. Torques apply for lightly oiled or dry threads. If lubricants, locking fluid or sealing compound are required for a screwed joint this information will be contained in the work description and in “Tightening Torques” Where no tightening torque is stated for a joint use the general tightening torques according to the tables below. The tightening torques stated are a guide and the joint does not have to be tightened using a torque wrench.

Dimension	**Tightening Torques**	
	Nm	**lbt.ft**
M5	6	4,4
M6	10	7,4
M8	25	18,4
M10	50	36,9
M12	80	59,0
M14	140	103,3

Tightening torques-protractor (angle) tightening



Tightening using both a torque setting and a protractor angle requires that first the recommended torque is applied using a torque wrench and then the recommended angle is added according to the protractor scale. Example: a 90° protractor tightening means that the joint is tightened a further 1/4 turn in one operation after the stated tightening torque has been applied.

Locknuts

Do not re-use lock nuts that have been removed during dismantling as they have reduced service life when re-used – use new nuts when assembling or reinstalling. For lock nuts with a plastic insert such as Nylock® the tightening torque stated in the table is reduced if the Nylock® nut has the same head height as a standard hexagonal nut without plastic insert. Reduce the tightening torque by 25% for bolt size 8 mm or larger. Where Nylock® nuts are higher, or of the same height as a standard hexagonal nut, the tightening torques given in the table apply.

Tolerance classes

Screws and nuts are divided into different strength classes, the class is indicated by the number on the bolt head. A high number indicates stronger material, for example a bolt marked 10-9 indicates a higher tolerance than one marked 8-8. It is therefore important that bolts removed during the disassembly of a bolted joint must be reinstalled in their original position when assembling the joint. If a bolt must be replaced check in the replacement parts catalogue to make sure the correct bolt is used.

Sealants

A number of sealants and locking liquids are used on the engines. The agents have varying properties and are used for different types of jointing strengths, operating temperature ranges, resistance to oil and other chemicals and for the different materials and gap sizes in the engines.

To ensure service work is correctly carried out it is important that the correct sealant and locking fluid type is used on the joint where the agents are required.

In this Volvo Penta Service Manual the user will find that each section where these agents are applied in production states which type was used on the engine.

During service operations use the same agent or an alternative from a different manufacturer.

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid.

Always follow the manufacturer's instructions for use regarding; temperature range, curing time and any other instructions for the product.

Tow different basic types of agent are used on the engine and these are:

RTV agent (Room temperature vulcanizing). Use for gaskets, sealing gasket joints or coating gaskets. RTV agent is clearly visible when a component has been dismantled; old RTV must be removed before the joint is resealed.

The following RTV agents are mentioned in the Service Manual: Loctite® 574, Volvo Penta 840879-1, Permatex® No. 3, Volvo Penta P/N 1161099-5, Permatex® No. 77. Old sealant can be removed using methylated spirits in all cases.

Anaerobic agents. These agents cure in an absence of air. They are used when two solid parts, for example cast components, are installed face-to-face without a gasket. They are also commonly used to secure plugs, threads in stud bolts, cocks, oil pressure switches and so on. The cured material is glass-like and it is therefore colored to make it visible. Cured anaerobic agents are extremely resistant to solvents and the old agent cannot be removed. When reinstalling the part is carefully degreased and then new sealant is applied.

The following anaerobic agents are mentioned in the Service Manual: Loctite® 572 (white), Loctite® 241 (blue).

NOTE! Loctite® is the registered trademark of Loctite Corporation, Permatex® is the registered trademark of the Permatex Corporation.

Part I Description

Aquamatic 270T with Internal Power Trim

The outboard drive model 270T can be hydraulically trimmed in and out underway, can be lifted to “Beach” underway at low speed, and can be lifted entirely with the boat stopped.

The hydraulic equipment is mounted on the inside of the mounting collar.

The moving parts of the lift cylinder and trim cylinder are protected against water by means of rubber bellows.

All operation of the drive is done from the operator’s seat. A trim indicator included in the instrumentation gives the position of the drive. This indicator has three fields, Trim, Beach and Tilt.

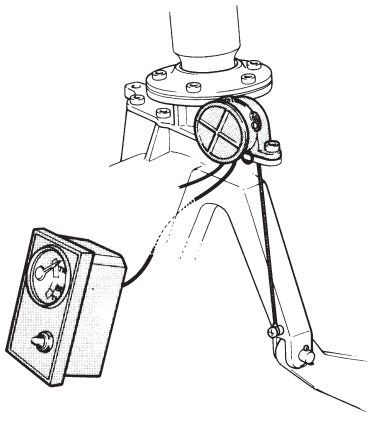
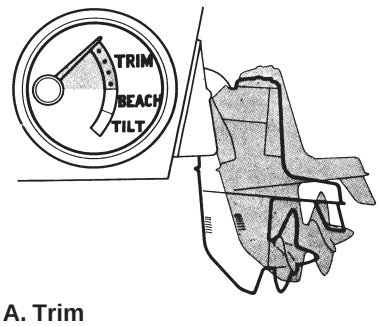
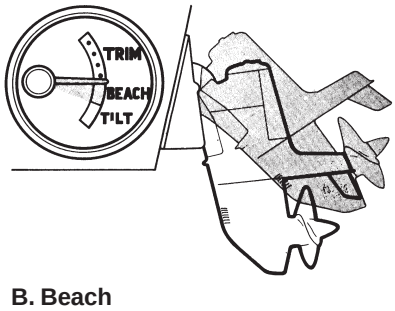


Fig. 1. Trim indicator and sender



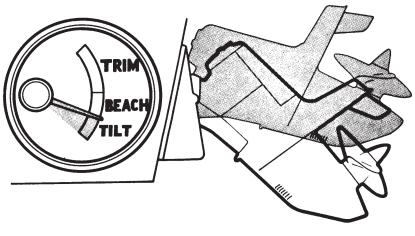
A. Trim

The drive is manoeuverable while underway for optimum performance.



B. Beach

The drive is manoeuverable within “Beach” while underway at low speed and idling, in order to be able to run in shallow water. Once the drive has been adjusted to this position, “Forward” and “Reverse” can be engaged and the speed increased.



C. Tilt

The engine must not be started or driven while the drive is within the tilt area. “Tilt” is intended to be used when the boat is moored in shallow water or when being transported on a trailer.

Fig. 2. Trim, Beach and Tilt

In addition to the mounting collar which is a special one for this drive, the main components in the hydraulic system for the drive 270T are: lift cylinder with lift yoke, trim cylinder and hydraulic tank. The lift cylinder and the hydraulic tank are mounted on the inside of the collar. The trim cylinder is fitted in a special trim cylinder housing on the outside of the collar.

The ingoing and outgoing push rods on the lift yoke and trim cylinder are well protected by rubber bellows against water and marine growth.

The lift cylinder, see Fig. 6, includes: a lift yoke (18), at the upper end of which a hydraulic piston (17) is attached, a control valve (19) with control lever (20), a safety release valve (14) and a safety valve (16).

The trim cylinder, see Fig. 3, includes: a hydraulic piston with push rod (24) and a pressure-equalizing pipe (33).

The hydraulic tank, see Fig. 5, includes: an electric drive motor (1) with hydraulic pump (7), hydraulic oil strainers (9), an oil dipstick (30), two relief valves (3 and 10), two non-return valves (5 and 8), two double valves for lifting (28) and lowering (27), also a “Beach” valve (11).

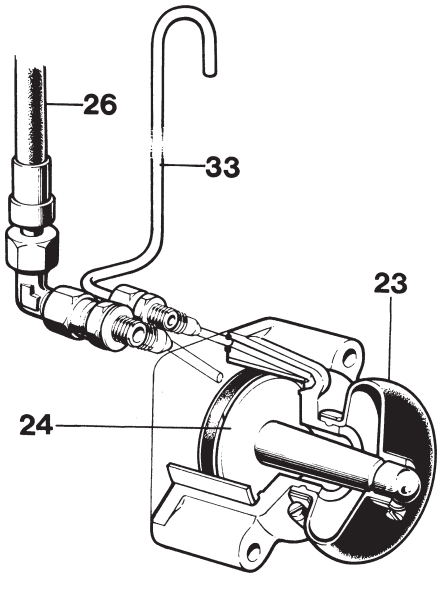


Fig. 3. Trim cylinder

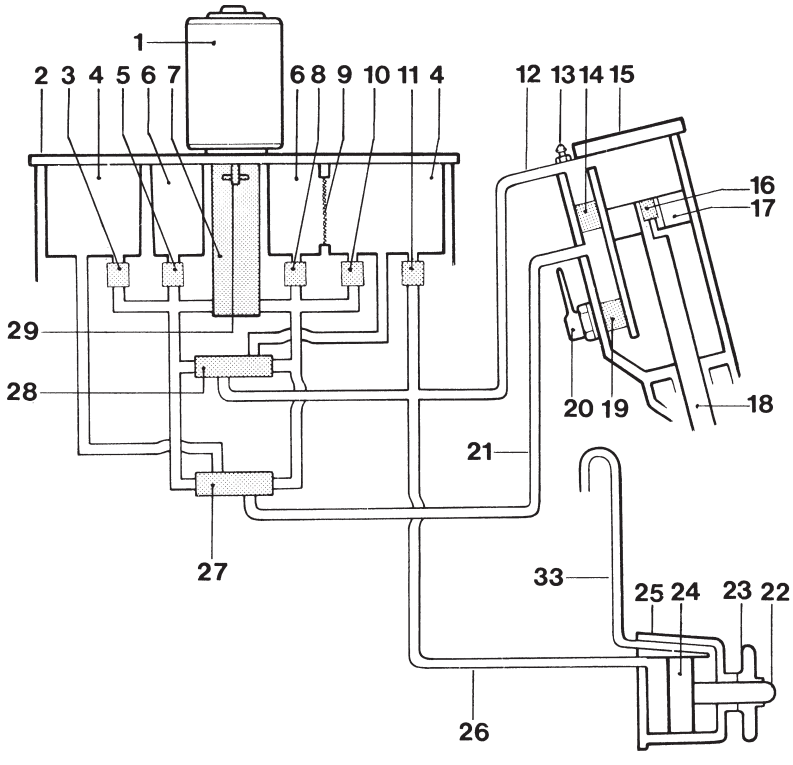


Fig. 4. Layout of hydraulic system for drive 270T

1. Electric motor
2. Oil tank cover
3. Relief valve, lifting
4. Return tank
5. Non-return valve for lifting
6. Supply tank, cleaned and vented oil
7. Hydraulic pump
8. Non-return valve for lowering
9. Oil strainer
10. Relief valve, lowering
11. “Beach” valve
12. Hose, lifting side
13. Nipple
14. Safety release valve
15. Lift cylinder
16. Safety valve
17. Piston, lift cylinder
18. Lift yoke
19. Control valve, closes when reversing
20. Control lever
21. Hose, lowering side
22. Contact surface, trim cylinder – drive
23. Rubber bellows
24. Piston, trim cylinder
25. Trim cylinder
26. Hose for trim cylinder
27. Double valve, lowering
28. Double valve, lifting
29. Electric motor drive pin
30. Oil dipstick
31. Oil filler hole
32. Transport plug
33. Pressure-equalizing pipe, trim cylinder

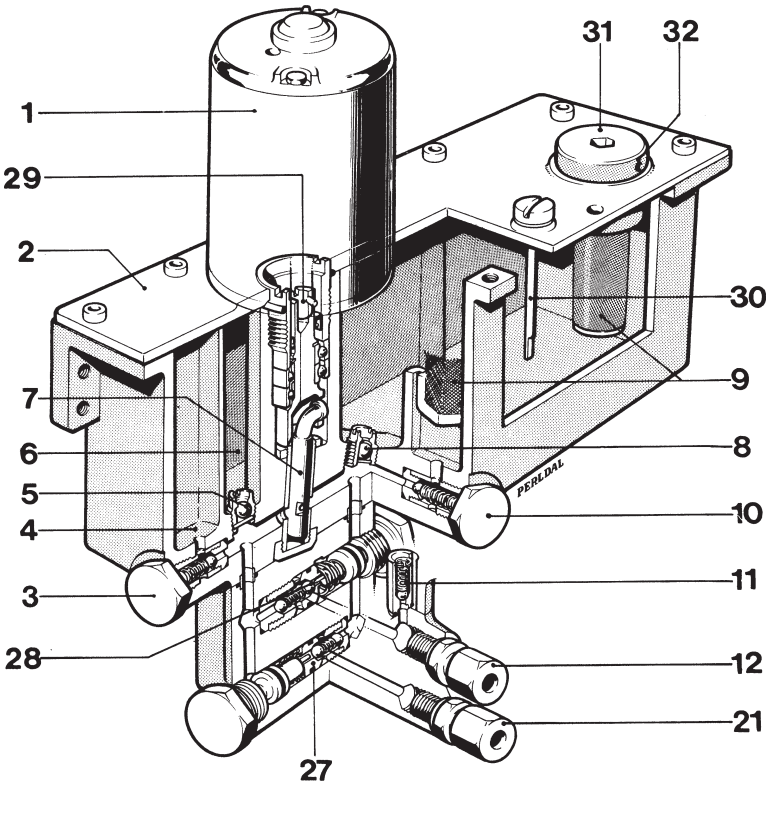


Fig. 5. Hydraulic tank

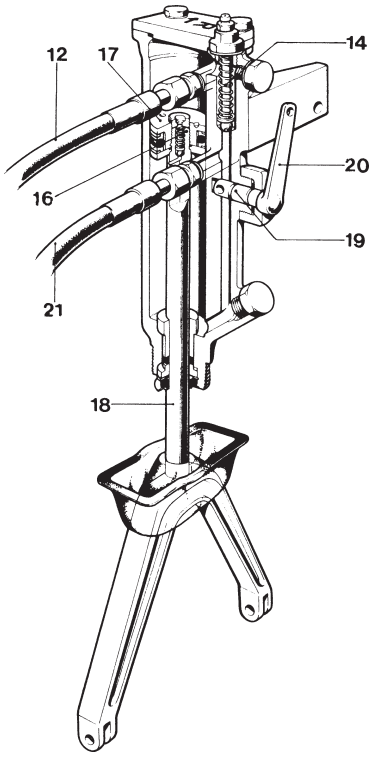


Fig. 6. Lift cylinder

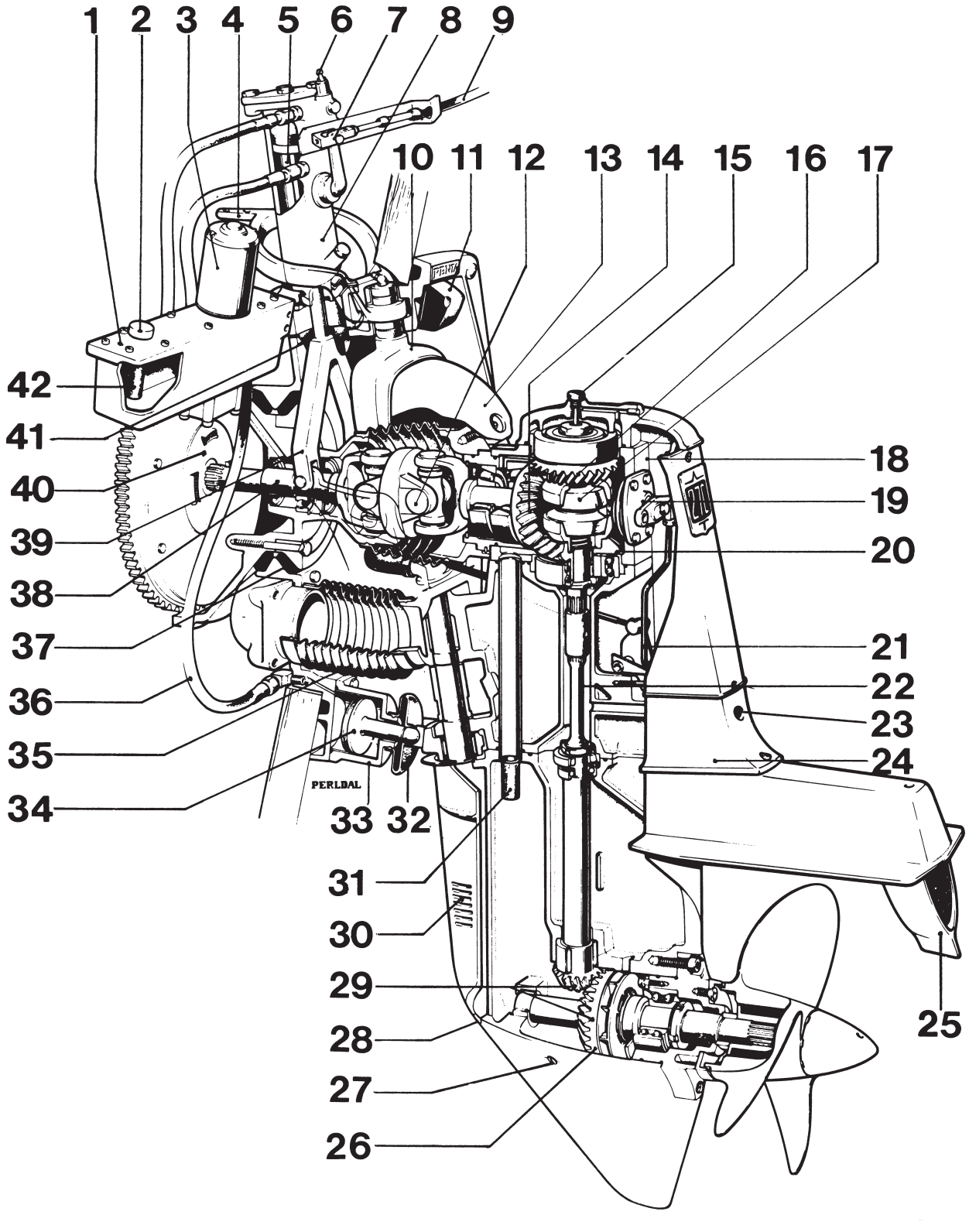


Fig. 7. Cross-section through outboard drive model 270T

1. Hydraulic tank
2. Oil filler hole
3. Motor for pump
4. Steering rod
5. Piston, lift cylinder
6. Air nipple
7. Control lever
8. Lift cylinder
9. Control cable
10. Steering yoke
11. Rubber block
12. Universal joint
13. Steering casing
14. Input gear
15. Oil dipstick
16. Gear
17. Cone clutch
18. Upper gear housing
19. Shift mechanism
20. Gear
21. Shift fork
22. Vertical drive shaft
23. Oil filler hole
24. Intermediate housing
25. Trim tab
26. Circulation pump
27. Oil drain
28. Water intake
29. Propeller gear
30. Water intake
31. Oil strainer
32. Rubber bellows
33. Trim cylinder
34. Piston, trim cylinder
35. Exhaust bellows
36. Hose
37. Supporting rubber pad
38. Drive shaft
39. Lift yoke
40. Vibration damper
41. Rubber bellows
42. Oil strainer

Part II Function

Function

The hydraulic system is so designed that it has a safety release valve, which reacts when the drive strikes an underwater obstacle, and a safety valve which prevents incorrect operation of the hydraulic system. Normally, the system thus does not reach excessive pressures.

The drive must not be trimmed or lifted when reverse is engaged, nor must the drive be lifted to “Tilt” when the engine is running.

When the boat is running “Forward”, the drive can be trimmed in and out for optimum performance, irrespective of the speed; and when the boat is operated at low speed in shallow water, the drive can be lifted to “Beach”. Reversing can be carried out without the possibility of the drive floating up.

With only trimming of the drive, the following takes place in the hydraulic system:

1. The electric motor (1), Figs. 8 and 9, and the hydraulic pump (7) start.
2. Oil is sucked from the tank (6) through the non-return valve (8).
3. Oil is forced under pressure from the pump (7) to the double valve (28).
   At the same time, the non-return valve (5) closes and the double valve (27) opens so that the return oil from the lift cylinder can pass through it.
4. Oil is forced further from the double valve (28) through the hydraulic hose (12) to the lift cylinder (15), see also Fig. 10, and the trim cylinder (25), see also Fig. 11, which operate in parallel as long as the trim cylinder is not at its extreme trim position.
5. Oil under the piston in the lift cylinder is pressed through the control valve (19) which at “Forward” and “Neutral” is open. From there it continues through the hydraulic hose (21) in return to the tank via the double valve (27). Before the oil goes out again into the system, it passes through a strainer (9).

   The trim cylinder (25) has oil only on one side. The opposite side of the piston operates in an air space which opens out into the boat via a pressure-equalizing pipe (33), see also Fig. 11.

When the drive is being trimmed, it moves slowly due to the fact that the lift cylinder and the trim cylinder work in parallel. During continued lifting of the drive, it moves much more quickly.

When the drive is being lifted from “Trim” to “Beach” and “Tilt”, the following takes place in the hydraulic system.

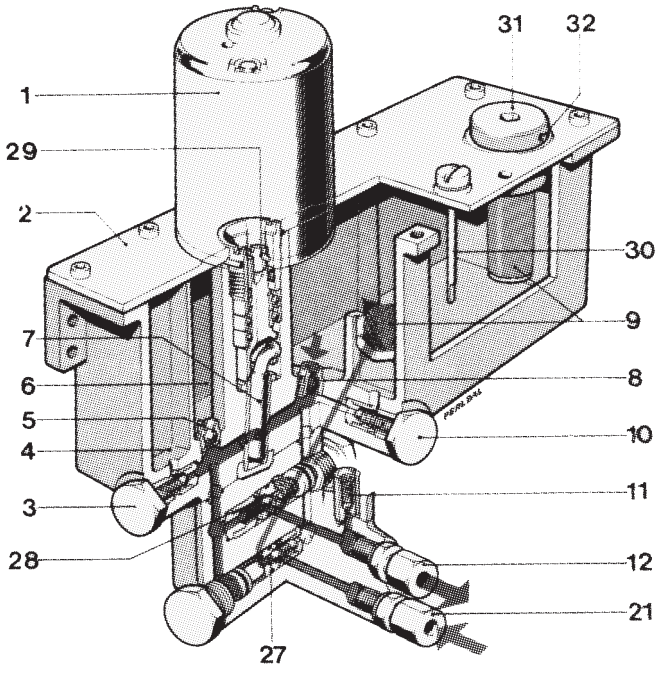


Fig. 8. Hydraulic tank, lifting the drive

Red = The path of the hydraulic oil through the valve housing with built-up air pressure
Blue = The return oil to the tank from the lift cylinder. bottom side

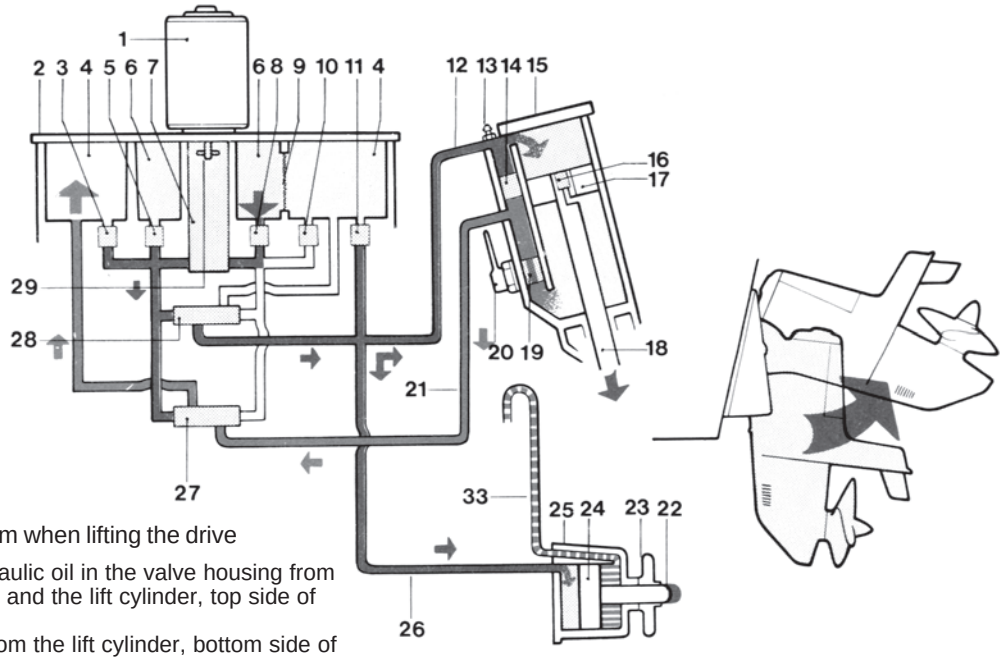


Fig. 9. Function of hydraulic system when lifting the drive

Red = The path taken by the hydraulic oil in the valve housing from the tank to the trim cylinder and the lift cylinder, top side of the piston
Blue = The return oil to the tank from the lift cylinder, bottom side of piston

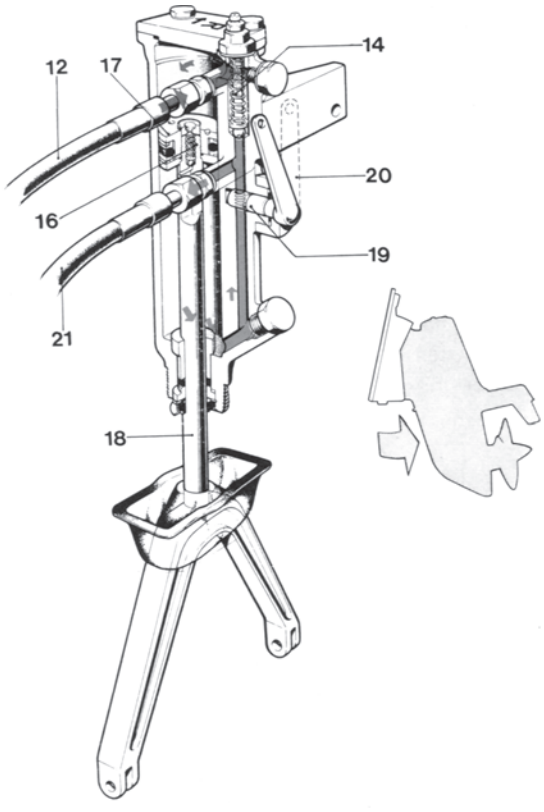


Fig. 10. Lift cylinder, when lifting the drive

Red = The hydraulic oil to the top side of the piston
Blue = The hydraulic oil from the bottom side of the piston returning to the tank

1. The oil takes the same path as when trimming and lifting, the difference now being that the lift cylinder alone lifts the drive from the trim area to the fully tilted-up position.

When the drive is being lowered from “Tilt, (lift)” – or – “Beach”, the following takes place in the hydraulic system:

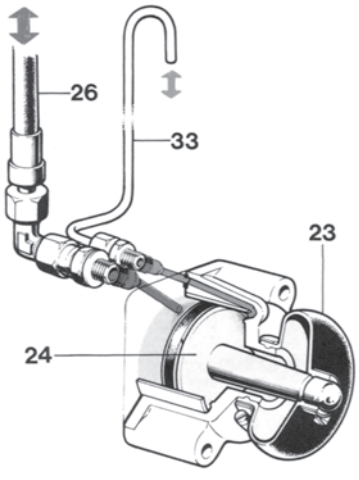


Fig. 11. Trim cylinder, trimming the drive

Red = The hydraulic oil to the front of the piston
Blue = The air channel for pressure equalizing in the air space at the back of the piston

1. The electric motor and the hydraulic pump start.

2. Oil is sucked from the tank (6) through the non-return valve (5), see Figs. 12 and 13.

3. Oil is pressed from the pump (7) to the double valve (27). At the same time, the non-return valve (8) closes and the double valve (28) opens so that the return oil from the lift cylinder (15) can pass through it.

4. From the double valve (27) the oil is pressed further through the hydraulic hose (21) to the lift cylinder where it passes through the control valve (19).

5. Oil above the piston in the lift cylinder is pressed back to the tank via the double valve (28). Before the oil goes out again into the system, it passes through a strainer (9).

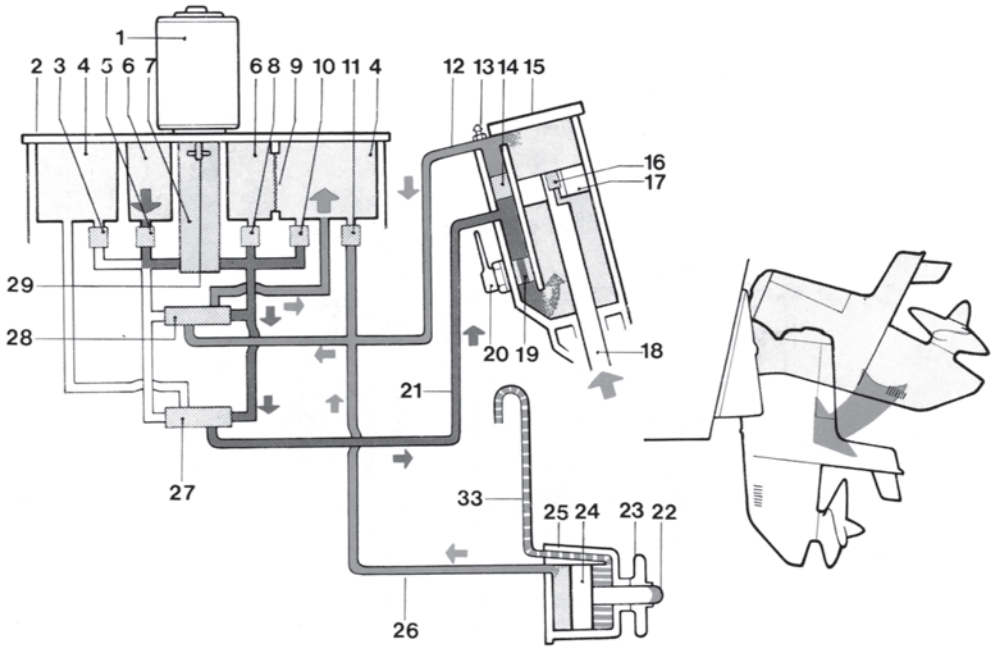


Fig. 12. Hydraulic function layout when lowering the drive

Red = The path of the hydraulic oil in the valve housing from the tank to the lift cylinder, bottom side of the piston
Blue = The return oil to the tank from the lift cylinder and the trim cylinder

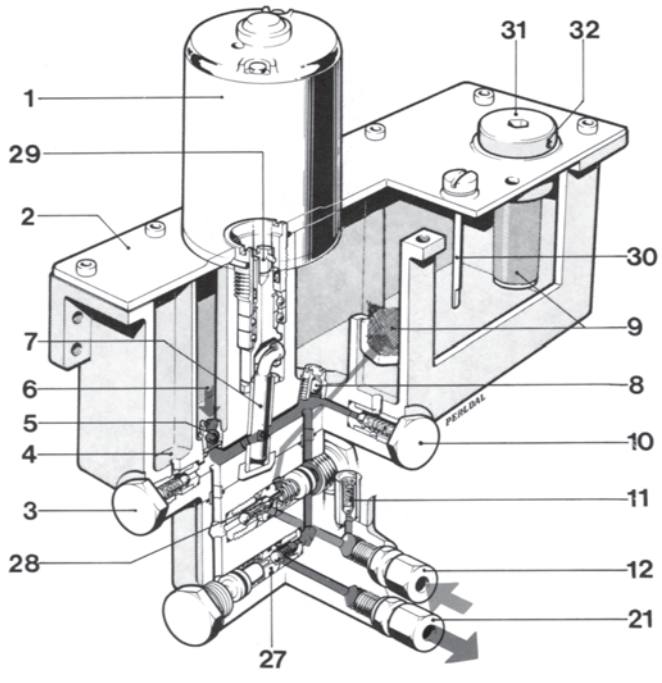


Fig. 13. The hydraulic tank, when lowering the drive

Red = The path of the hydraulic oil through the valve housing with built-up lowering pressure
Blue = The return oil to the tank, from the lift cylinder and the trim cylinder

6. During continued lowering manoeuvers from the trim area, the trim cylinder is also pushed in with the help of the lift cylinder. The return oil from the trim cylinder passes through the double valve (28) before it reaches the tank.

Should the drive strike an underwater obstacle, or is incorrectly manoeuvered or overloaded, the following takes place in the hydraulic system:

The drive strikes an underwater obstacle:

1. Should the drive strike an underwater obstacle, any oil that is under the piston in the lift cylinder must be rapidly evacuated. To avoid overloading the system, the safety release valve (14) then opens in the lift cylinder housing, see Fig. 14.

2. When the safety release valve (14) – the drive strikes an underwater obstacle – opens, oil rushes through it and up to the top of the piston. Because of the volume of the push rod under the piston, there will be a difference in volume between the top and bottom of the piston. This means that when the drive kicks up because it strikes an underwater obstacle, a partial vacuum arises at the top of the piston and this causes the drive to go down partly when it has passed the obstacle. The drive must subsequently be run down the last bit.

If the control lever (20) is at the port side, that is, “Reverse”, then the control valve (19) is closed and the safety valve in the housing cannot be opened.

During incorrect manoeuvering of the drive, that is, attempting to lift the drive when reverse gear is engaged, the following takes place in the hydraulic system:

1. The electric motor (1) and the hydraulic pump (7) start.

2. The hydraulic oil is pumped as we described under ”Trimming”.

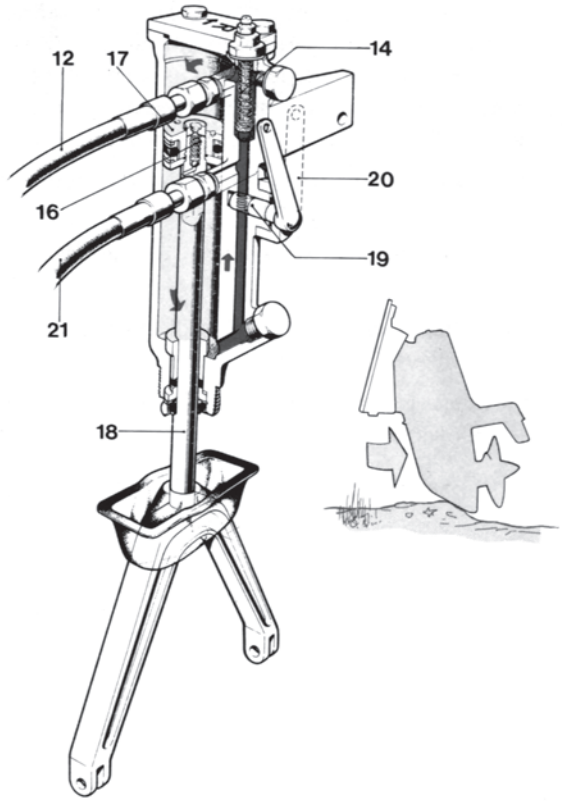


Fig. 14. Lift-cylinder, the safety release valve opens when drive strikes underwater obstacle

3. When reverse gear is engaged, the control valve (19, Fig. 15) is closed, and this means that any oil under the piston in the lift cylinder cannot pass to the top side of the piston via this cylinder.

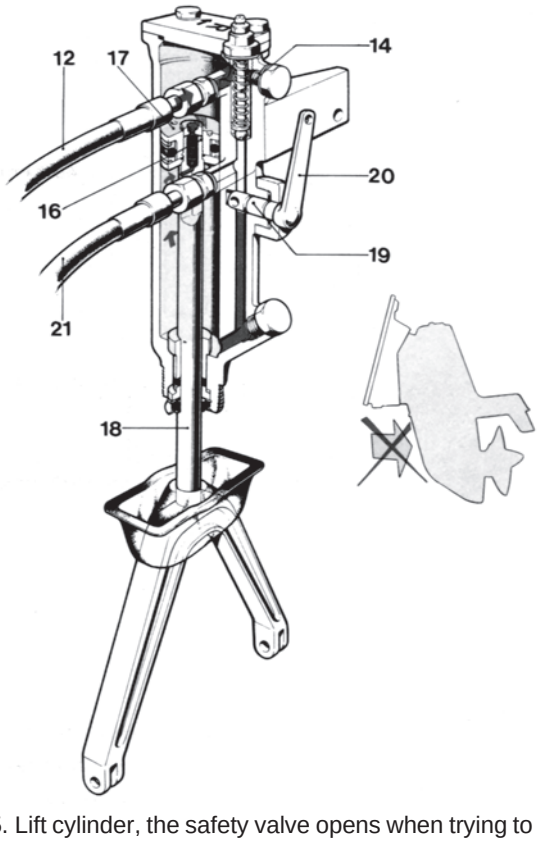


Fig. 15. Lift cylinder, the safety valve opens when trying to lift drive with reverse gear engaged

When a certain pressure has been built up by the trim cylinder under the piston of the lift cylinder, a safety valve (16) opens in the lift cylinder piston (17) through which the oil can pass to the top side of the piston.

4. When the trim cylinder has reached its outer position, the drive will stop at this position since the safety valve in the piston of the lift cylinder only opens from the pressure caused by the trim cylinder.

The hydraulic system is so constructed that the boat can be driven and manoeuvered with the drive partly tilted up, that is, at “Beach”. In order to protect the hydraulic system from overloading caused by excessive propeller thrust, there is a safety valve (a “Beach” valve) built into the hydraulic tank.

Should any overloading occur, the following takes place in the hydraulic system:

1. The drive is pressed down and the piston in the lift cylinder is pressed upwards.
2. The hydraulic oil on the top side of the piston is pressed back to the hydraulic tank via the safety valve (the “Beach” valve).
3. Oil is sucked from the tank to the bottom of the piston in the lift cylinder.

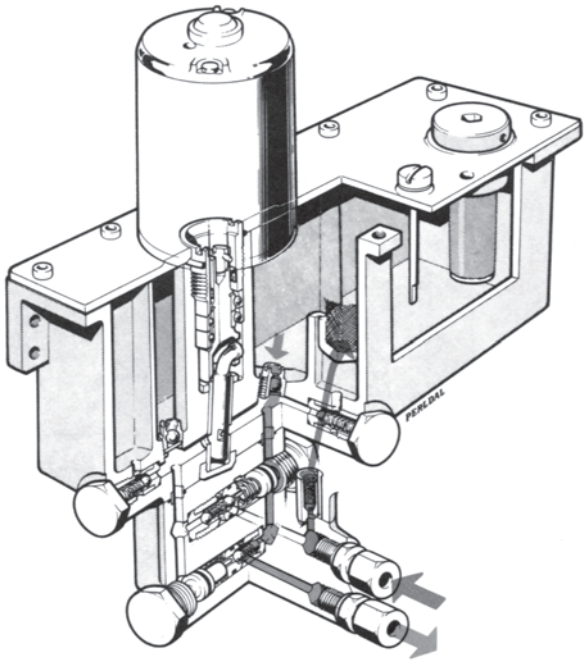


Fig. 17. Hydraulic tank, the “Beach” valve opens with overloading when running in “Beach”

Red = The path of the hydraulic oil through the valve housing when the “Beach” valve opens
Blue = The return oil from the tank to the lift cylinder, bottom side of the piston

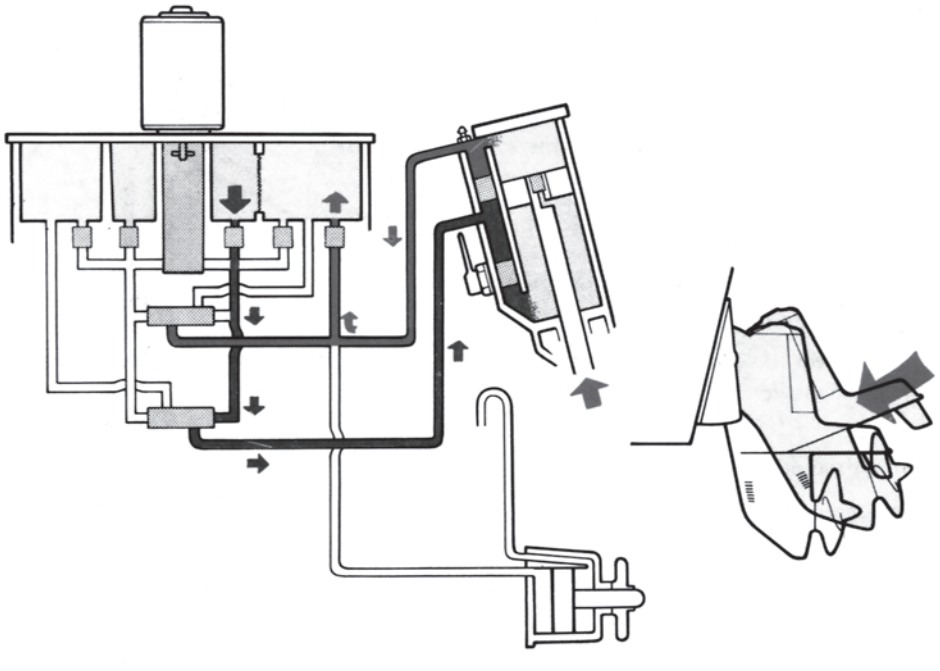


Fig. 16. Hydraulic function layout, overloading when running in “Beach”

Red = The hydraulic oil is pressed through the “Beach” valve to the tank, from the lift cylinder, top side of the piston
Blue = The oil is sucked from the tank to the lift cylinder, bottom side of the piston

Part III Fault-tracing scheme

Drive does not lift	Drive lifts partly or hesitantly	Drive drops from tilted-up position	Drive drops to "Beach" during running	Drive tends to float up during dethrottling	Drive kicks up when reversing	Drive drops partly or hesitantly		
								The scheme contains faults which can arise during normal operation and also any oversights when fitting, e.g., a deformed O-ring or a valve left out. Test the functions A to G and tick off those points from 1–20 that are not faulty. Concerning a description of points 1–20, see pages 16–18.
A	**B**	**C**	**D**	**E**	**F**	**G**		**Alternative faults**
•							1	Fault in electrical system
•							2	Broken drive pin
•	•						3	Transport plug not removed
•	•						4	Too low oil level in hydraulic tank
•	•						5	Relief valve (opens too soon)
•	•						6	Non-return valve does not close or leaks at the thread
•	•						7	Leak past the O-ring plunger for double valve
•	•	•	•				8	Leakage in double valve or its O-rings
•	•	•	•				9	Leakage in "Beach" valve or excessive propeller thrust
•	•	•	•			•	10	Leakage past the O-rings between the pump housing-valve housing
•	•	•	•	•			11	Leakage in safety release valve
•	•	•	•	•	•		12	Leakage in safety valve
•	•	•	•	•	•		13	Leakage past the piston sealing in the lift cylinder
•	•	•	•				14	Leakage past the piston sealing in the trim cylinder
						•	15	The relief valve opens too soon
						•	16	The non-return valve does not close or leaks at the thread
				•		•	17	Leakage in the double valve or its O-rings
						•	18	Leakage past the O-ring plunger for the double valve
					•		19	The control valve does not close
				•	•		20	Leakage past the piston rod sealing in the lift cylinder

Part IV Checking the oil pressure and sealing

A. DESCRIPTION OF FAULT-TRACING SCHEME POINTS 1–20

In those cases where remedies of faults are not given, refer to the respective section on reconditioning.

1 Faults in the electrical system

Check all electrical connections for corrosion and electrical cables for breakage.

2 Broken drive pin

The pump motor races. Remove the oil tank cover and replace the drive pin. The pin is fitted on the drive shaft of the electric motor (the electric motor is fixed to the cover). Fit only a genuine drive pin.
NOTE. Remember to remove any bits from the drive pin.

3 Transport plug

In the filler cap there is a hole for evacuating the hydraulic tank. This hole is plugged during delivery transportation. If the plug is not removed or if the hole is blocked when lifting the drive, a partial pressure will arise in the tank and thus prevent the pump from being able to suck oil so that is cavitates.

4 Low oil level

Due to the layout of the hydraulic system, the oil level in the tank is not constant. The oil level fails when trimming out and lifting the drive. Check, therefore, that the oil level is within the marking on the oil dipstick with the drive fully trimmed in. If the level is too low, lift the drive only partly and then listen to the pump motor racing without counterpressure.

5 Relief valve

The hydraulic system is provided with a relief valve. Its function is to prevent the hydraulic pump from being overloaded when the drive lifts and reaches the end position against the rubber block or when lifting the drive outside the trim area with high counterpressure from the propeller. This valve must not open at too low a pressure or allow the oil to leak past due to a defective O-ring.

To avoid overloading the drive motor, it is provided with a motor circuit breaker which cuts out the circuit after a brief moment.

Check the pressure by disconnecting the upper hose (12, Fig. 18) at the lift cylinder and the hose's T-union at the valve housing. Connect pressure gauge part No. 884418 to the valve housing and a sealing plug to the lift cylinder as well as a plastic plug to the T-union to avoid oil spill. See Fig. 18. Run the pump to the lift position. When the drive reaches the end position against the rubber block, it should have a pressure of minimum 63.5 kg/cm^2 (903 psi) and a rattling sound is heard at the same time from the relief valve. If too low a pressure is obtained, examine the valve and O-rings. See Part VI C.

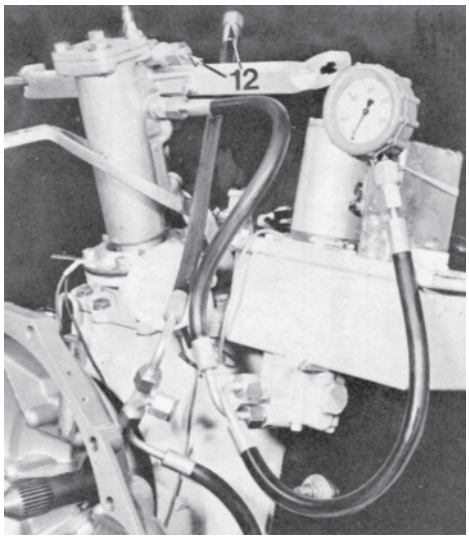


Fig. 18. Checking the relief valve for air pressure

After the test, re-fit the hose (12).

6 Non-return valve

The hydraulic system is so designed that the drive is lifted up or lowered by changing the direction of rotation of the electric motor. This causes the pump either to discharge or suck. If the drive does not lift, there may be leakage in the non-return valve on the discharge side, that is, the bolt does not seal or oil is leaking past at the thread. Moreover, the ball in the valve on the suction side may have jammed in the closed position.

The valves can be shifted for testing. A faulty valve should be replaced. See Part VI C.

7 Plunger

The hydraulic system does not need to be vented since this is done fully automatically when lifting the drive. The oil pressure influences a plunger in the double valve and this opens a passage via the non-return valve in the tank. Any air that is to be found at the bottom of the lift cylinder piston is then pumped back to the tank.

Check to make sure that the plunger runs easily and that its return spring presses it back. Also make sure that the O-ring is not damaged. See Part VI B.

8 Double valve

The double valve consists of two non-return valves and the plunger described above. The function of the non-return valves is to prevent oil from returning from the trim cylinder or lift cylinder when the drive has been trimmed out or lifted up. Both the valves are identical and can be interchanged for testing.

The double valve can be **checked** by disconnecting the upper hose on the valve housing and then by applying compressed air to the valve. If air has penetrated to the tank, the valve leaks or the O-rings are defective. See Part VI B.
NOTE. If air comes out of the “Beach” valve (A, Fig. 21), the fault is the same, see point 9. Replace faulty parts.

9 Beach valve

The hydraulic system is provided with a trim cylinder in order to obtain slow movement of the drive and large force during trimming. It also has a lift cylinder for more rapid lifting of the drive. With the drive tilted up to “Beach” (outside “Trim”) and when the boat is driven forwards with large propeller thrust, the piston in the lift cylinder will generate a very high pressure in the hoses and double valve. In order to limit this pressure and to make rapid lowering of the drive possible, the hydraulic pump has been fitted with a safety valve, called the “Beach” valve.

Check the valve with a pressure gauge (part No. 884418) connected between the valve housing and the upper hydraulic hose. The T-union should be used. Lift the drive to ”Beach”, start the engine and engage “Forward”. Gradually increase the speed of the engine while reading off the pressure at the same time when the drive drops into the trim cylinder.

Opening pressure 140+/–10 kp/cm^2 (1990+/–142 psi). If too low a pressure is obtained, replace the ”Beach” valve, see Part VI A, C and D.

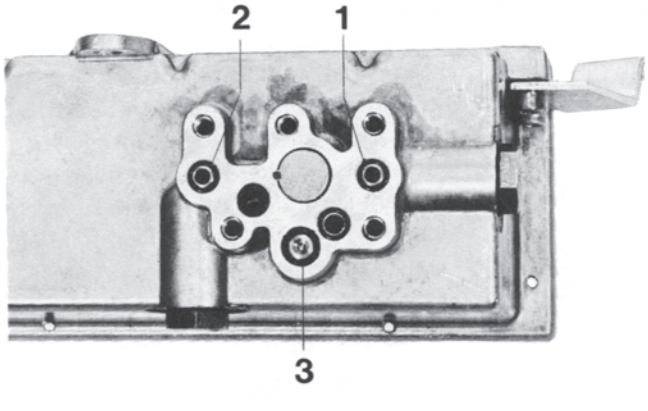


Fig. 18a. O-rings between pump housing – valve housing

1. Lifting side
2. Lowering side
3. “Beach” valve

10 O-rings between pump housing-valve housing

All the channels between the pump housing and valve housing are sealed against leakage with O-rings.

When testing according to points ABCD (see the fault-tracing scheme), the O-rings 1, see Fig. 18a, are defective. When testing according to point G, the O-rings 2 are defective. When testing according to points CD, the O-ring 3 is defective.

Concerning replacement of O-rings, see Part VI A and D.

11 Safety release valve

In the lift cylinder there is a channel through which the oil passes from the bottom of the piston to its top. The flow through this channel is regulated partly by a control valve (see point 19) and partly by a safety release valve. The spring pressure on the ball in the safety release valve is so adapted that the valve does not open under the pressure that arises in the system during abrupt throttling. If the drive should strike an obstacle under the water while the boat is underway, the valve opens and the drive kicks up.

Check the valve with drive tilted down. Disconnect the lower hose on the lift cylinder and connect gauge, part No. 884418, to the cylinder. Disconnect the control cables from the control valve lever. Move the lever to position “F”. Thereafter engage “Reverse” on the drive and gradually increase the speed. Opening pressure 90±10 kp/cm^2 (1280±142 psi). If a pressure lower than this is obtained, examine the valve, see Part VII. The fault may also be defective sealing rings (13, 20) or a defective safety release valve (12).

12 Safety valve

A safety valve with very high opening pressure is built into the upper end of the lift cylinder’s piston rod.

With wrong manoeuvering, that is, attempting to trim out the drive with reverse engaged, this safety valve protects the hydraulic system from reaching excessive pressure.

The spring pressure on the ball in the safety valve is so adapted that the valve opens with wrong manoeuvering but not when reversing.

The opening pressure is 300+/–20 kp/cm^2 (4200+/–280 psi).

13 Piston sealing in lift cylinder

The piston of the lift cylinder has a double-operating hydraulic sealing with plastic support rings.

This sealing can be **checked** by tilting up the drive and keeping it in this position while removing the upper hose from the lift cylinder. Plug the connection on the lift cylinder. The top side of the piston is now filled with oil and its outlet is plugged. If the drive drops when pressed downwards, the piston sealing should be examined. Any faulty piston sealing should be replaced. See Part VII. If the piston sealing is not damaged, the valves according to points 11 and 12 should be checked.

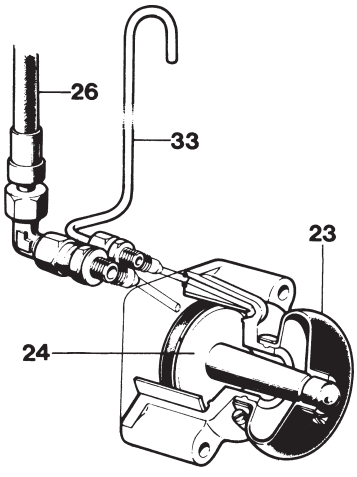


Fig. 19. Trim cylinder

14 Piston sealing in trim cylinder

The piston sealing in the trim cylinder consists of an O-ring with plastic support ring.

With leakage past the seal (24, Fig. 19), the bellows (23) fill with oil. If this leakage is considerable, the oil will force its way out of the evacuation pipe (33). Check and make sure when replacing the O-ring that the support ring is behind the O-ring (next to the protective bellows). NOTE. If water drips from the pipe, the rubber bellows (23) for the trim rod is leaking. Concerning reconditioning, see Part VIII.

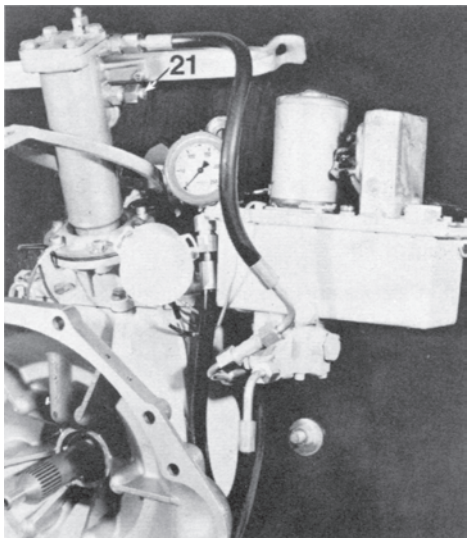


Fig. 20. Checking lowering pressure of hydraulic pump

15 Relief valve

A relief valve protects the hydraulic pump from overloading when the drive reaches its maximum trim-in position during the lowering manoeuver. This valve must not open at too low a pressure, nor must it leak due to a defective O-ring.

Check the pressure by disconnecting the lower hose (21, Fig. 20) at the lift cylinder and the valve housing. Connect up the pressure gauge, part No. 884418, to the valve housing and plug the disconnected end of the lift cylinder. Run the pump to the lowered position.

When the drive has reached its maximum trim-in position (bottom position), there should be a pressure of minimum 36.5 kp/cm^2 (519 psi), and at the same time a chattering sound should be heard from the relief valve. If too low a pressure is obtained, check the valve and the O-rings. See Part VI C. After the test, re-fit the hose (21).

16 Non-return valve

This valve is concerned with the lowering of the drive and has the same function as the valve according to point 6.

17 Double valve

This valve is concerned with the mechanism for lowering the drive and has the same function as the valve according to point 8.

The valve can be **checked** by disconnecting the lower hose on the valve housing and then by applying compressed air to the valve. If air penetrates into the tank, then the valve must be leaking or the O-rings must be defective. Replace faulty parts. Se Part VI C.

18 Plunger

The plunger is concerned with the opening of the mechanism for lowering the drive and has the same function as the plunger according to point 7.

19 Control valve

During reversing, pressure arises at the bottom of the lift cylinder's piston. When the control valve is adjusted for reversing "R", the connection between the bottom of the valve and the return line is closed. Both trimming and lifting of the drive can only be carried out with the control valve (control lever) in "Forward" and "Neutral". With faulty manoeuvering, the safety release valve opens (see point 12). Check to make sure that the O-rings on the control valve are in good condition. If the inner O-ring is defective, this may give rise to pressure on the inside of the valve, with the result that manoeuvering will be stiff. See Part VII.

20 Plunger rod sealing

With leakage in the plunger rod sealing, oil will leak out into the protective bellows on the lift yoke. Concerning reconditioning, see Part VII.

B. SEALING TEST WITH HYDRAULIC TANK (PUMP HOUSING) REMOVED

For removing and reconditioning, see the respective points in Part VI.

The numbers on the valves refer to the corresponding numbers in the “Fault-tracing scheme”.

Allow the oil to remain or fill the oil tank with kerosene (paraffin). Unscrew the oil tank cover. Remove the plastic plug for the upper hose connection and with compressed air blow in the connection hole and at the same time inspect the holes in the bottom of the oil tank, see Fig. 21. If bubbles come from any hole, then a valve is leaking according to the following marking:

HOLE A = Beach valve 9

HOLE B = Double valve 8

HOLE C = Relief valve 5

HOLE D = Double valve 8. The non-return valve 6 does not close at so low a pressure.

Thereafter carry out the same test by blowing in the lower connection hole. The marking will then be:

HOLE E = Double valve 17

HOLE F = Relief valve 15

HOLE G = Double valve 17. The non-return valve 16 does not close at so low a pressure.

Clean the valve that is leaking and re-test. If cleaning does not help, the valve concerned must be replaced with a new one.

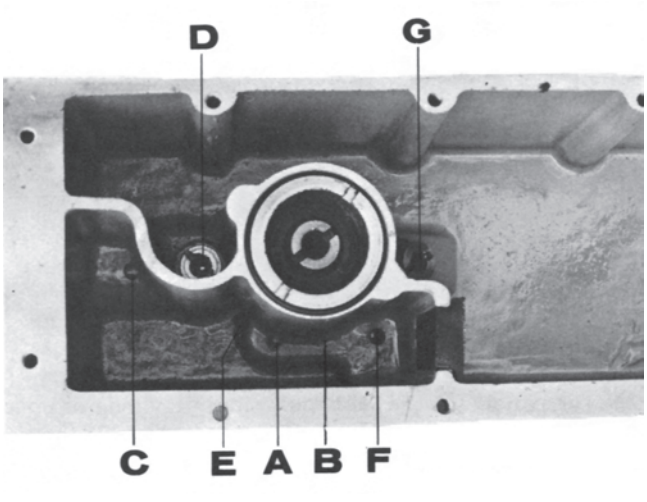


Fig. 21. Marking of holes in bottom of oil tank

Part V Removing the outboard drive

1. Run the drive down to its bottom position.

Remove the lock bolt for the steering rod, on the inside of the transom. See Fig. 22.

Fig. 22. Removing the steering rod

Remove the control cables from the control lever of the lift cylinder. See Fig. 23.

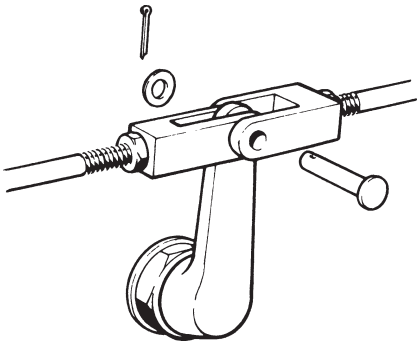


Fig. 23. Removing the control cables

2. Remove the centre bolt for the steering casing and the aft clamp on the universal joint bellows. The steering yoke (together with the steering casing) can now be removed. Remove the steering yoke carefully downwards past the centre bolt attachment. See Fig. 24.

NOTE. Observe due care with the sealing ring and the lubricating nipple. If the sealing ring is damaged, it should be replaced.

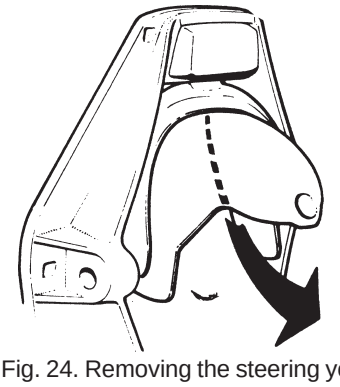


Fig. 24. Removing the steering yoke

3. Remove both the lock bolts for the shaft pins in the mounting collar. See 1, Fig. 25.

Remove the casing over the shift mechanism. Disconnect the control cable 2 from the yoke 3 and screw off the cube. Remove the control cable's lock plate which is fitted at the front 4 of the intermediate housing. Release the two split-pin bolts 5 of the lift yoke. Lift up the drive by hand and release the hose clamps for the cooling water hose and the exhaust bellows. Then let down the drive.

Prop up the drive under the tab in order to off-load the shaft pins (6). Push or knock out the axle pins with a brass tool (insert a screwdriver in the grooves and twist) and release the drive from the mounting collar.

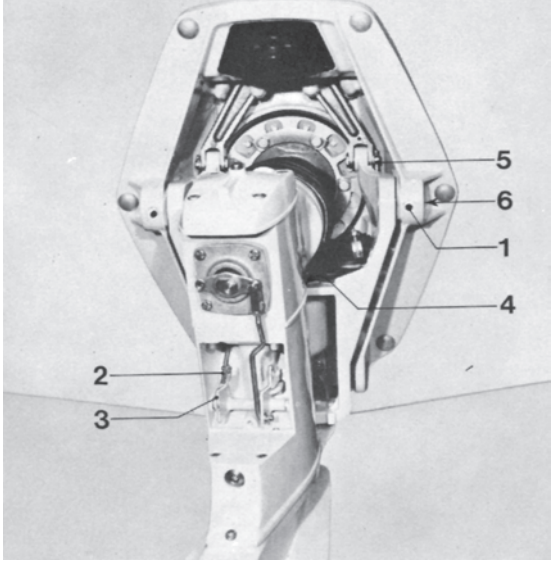


Fig. 25. Removing the outboard drive

Part VI Reconditioning the hydraulic pump and valve housing

A. REMOVING AND SEPARATING THE OIL TANK (PUMP HOUSING) AND VALVE HOUSING

1. Disconnect the hydraulic hoses (12 and 21, Fig. 26) at the valve housing. Plug both hoses and valve housing (plastic plugs).
2. Remove the relay bracket (34) and disconnect the electric cables for the electric motor (1). Check to make sure that the cables are marked.
3. Remove the oil tank from the transom and take care of the oil.
4. Disconnect the valve housing from the tank, noting the O-rings (five for the oil channels) and the “Beach” valve (11) which is loosely pushed into its seat underneath the tank.

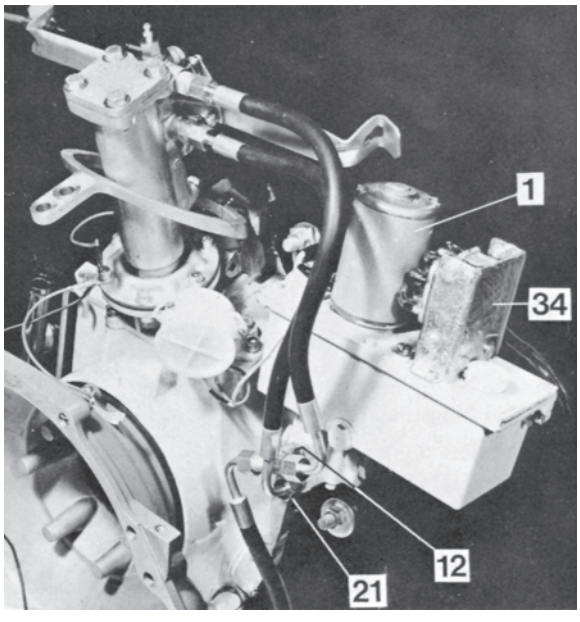


Fig. 26. Removing the oil tank from the transom

B. RECONDITIONING THE TWIN VALVES IN THE VALVE HOUSING

The valves are identical and can be interchanged.

Removing

1. Remove the plug (1), Fig. 27, and the packing (2).
2. Pull out the piston (3) (e.g. with a pair of pliers). The O-ring (4) is fitted on the piston.
3. Take out the spring (5) (small diameter facing the piston).
4. Screw out the valve (6). The O-ring (7) is fitted on the valve (use a screwdriver of the same width as the valve groove).
5. Take out the inner O-ring (8).
6. Check the valve parts. Replace parts that are damaged.

Fitting

All parts must be absolutely clean before being re-fitted.

7. Place the O-ring (8) in position in the bottom of the valve seat.
8. Screw in the valve (6) with the O-ring (7) fitted and tighten up.
9. Fit the spring (5) on the piston (3) with the small diameter over the piston neck and stem. Fit the O-ring (4) on the piston (3) and place the piston/spring in the valve housing with the spring facing the valve (6). Check to make sure that the valve runs easily.
10. Screw on the plug (1) and the packing (2) and tighten up the plug.

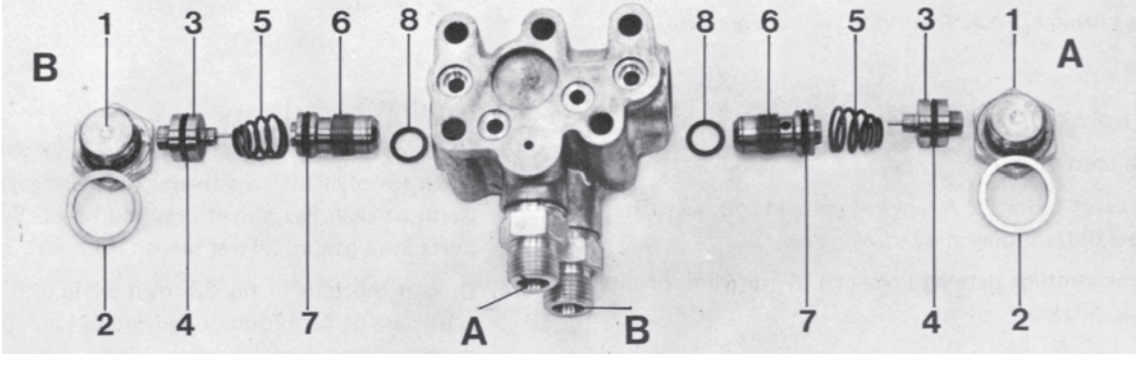


Fig. 27. Valve housing removed

A = Pressure side when lifting drive

B = Pressure side when lowering drive

C. RECONDITIONING THE HYDRAULIC PUMP AND THE VALVES IN THE TANK

Removing

Tools that might damage the fine finish on the parts of the valves should not be used.

Beach valve

1. Shake out the "Beach" valve (13, Fig. 28) which is loosely recessed in its seat underneath the tank.

Non-return valves

2. Unscrew the dipstick (26) and the plug (25) and lift out the filler strainer (24).

Screw off the oil tank cover (33).
NOTE! the gasket (34). The electric motor (1) accompanies the cover. Check the drive pin on the electric motor. If the pin has broken, it is important that all the bits of the pin are removed.

The strainer (23) between the large and small chambers in the tank is pressed down into a groove and can be pulled straight up, note its position.

3. Screw off the non-return valves (9) in the bottom of the tank. The valves are identical and can be interchanged.

Relief valves

4. Unscrew the relief valve, for lowering pressure (10 A marked with 1 on the hex head) and two O-rings (11 and 12). The valve is a complete unit and cannot be taken apart.

5. Unscrew the relief valve for lifting pressure (10 unmarked) together with two O-rings (11 and 12).

Hydraulic pump

6. Unscrew the sleeve (8). (Note. The grooves in the upper edge of the sleeve must not be deformed.)

7. Knock the sealing ring (6) out of the sleeve (8).

8. Lift up the drive shaft (4, complete with piston 2, two ball bearings 5 and circlip 7). Rotate the drive shaft to the position where it can be taken up. **NOTE!** Do not use force.

9. Remove the circlip (7) and pull off the two ball bearings (5).

Replacing piston and pump liner

10. Unscrew the nut (3).

11. Knock out the liner (2A) using a metal drift. The lock pin in the bottom of the liner will accompany it.

12. Clean all parts thoroughly and replace those that are defective.

Fitting

NOTE! All parts must be absolutely clean before being re-fitted.

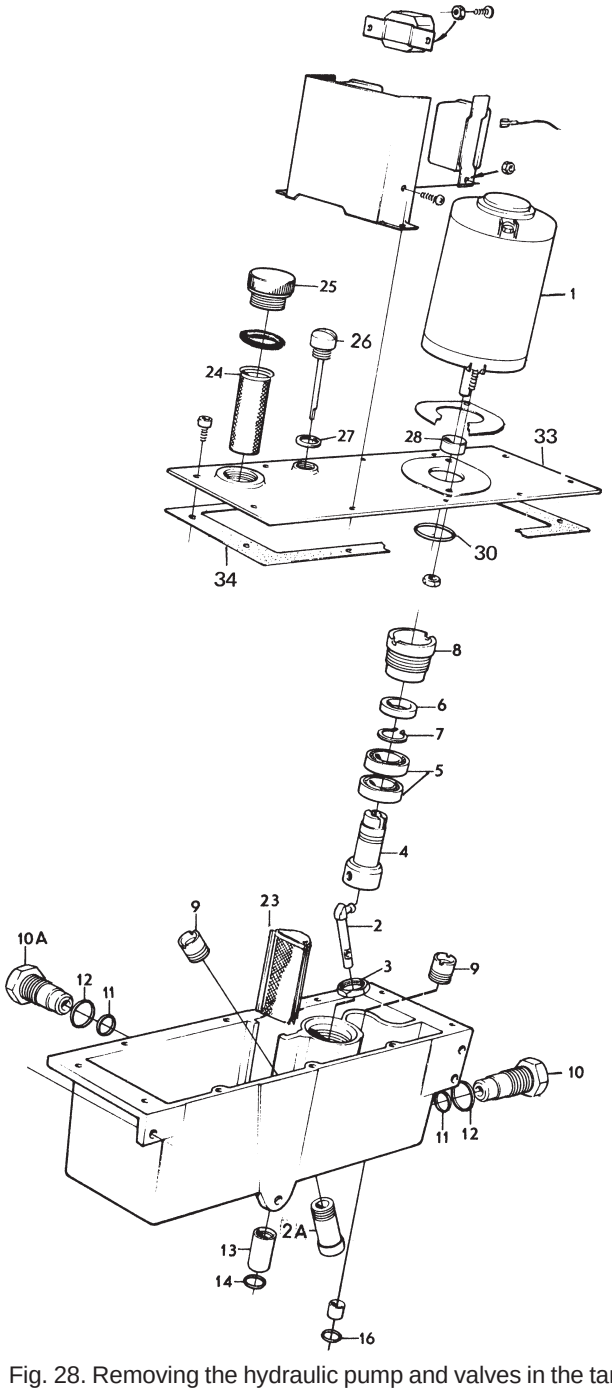


Fig. 28. Removing the hydraulic pump and valves in the tank

Pump liner

13. When fitting the pump liner (2A, Fig. 28), it is important that the holes for the oil channels are fixed properly. The recess in the liner for the lock pin should coincide with the recess in the housing. See 1, Fig. 29. Line-up also through the lift valve (10) channel.

14. Tighten up the nut (3, Fig. 28) to a torque of 5 Nm (3.5 lbft). Do not tighten the nut too hard as otherwise this might alter the shape of the liner.
NOTE! Lock the nut with Locktite. Fix the liner in its proper position with a drift or similar tool in the oil channel while tightening the nut.

15. Tap the lock pin (1, Fig. 29) in the bottom of the liner.

Hydraulic pump

16. Fit both the ball bearings (5, Fig. 28), they are both similar, on the drive shaft (4) and lock with the circlip (7). Turn the circlip so that the opening is in line with one of the side holes in the drive shaft.

17. Lubricate the piston, drive shaft and bearing with hydraulic oil.

The piston can only be fitted in one way. Cut out a paper gauge according to Fig. 30. Place the piston in the liner and turn the piston arm so that it points from the suction channel. Press down the piston to the right depth by means of the gauge. Hold the piston in this position with a pin inserted through the suction channel (see Fig. 30). Now move the drive shaft down over the piston until the hole coincides with the piston arm (the opening of the circlip 7 marks the position of the hole). Center the bearings and press the drive shaft to the bottom while removing the pin at the same time. See Fig. 31. At the bottom position, the bearings should be 0.5 cm (0.2") under the threads.

18. Press the sealing ring (6, Fig. 28) in the sleeve (8) to the shoulder (with the open part away from the shoulder) and fit the sleeve over the drive shaft.

Relief valves

19. Fit the O-ring (12) on the relief valve 10A, for lowering pressure (marked with 1 on the hex head). Then place the O-ring (11) in the bottom on the seat. Check that the valve insert is not loose. Screw the valve tight in the tank. While fitting, hold the tank in such a position that the O-ring (11) is not moved from its position.

20. Fit the relief valve 10, for lifting pressure, in the same way as for valve 10A.

Non-return valves

21. Screw the non-return valves (9) tight in the bottom of the tank. The valves are identical and can be interchanged when testing.

Hydraulic tank cover

22. Press the protective ring (28, Fig. 28) far enough on the drive shaft (4) that it covers the entire groove.
NOTE! The protective ring (28) must not be pressed against the sealing ring (6).

Place the O-ring (30) round the sleeve (8).

Press down the strainer (23) between the small and large chambers in the tank (the pointed part facing the small chamber).

23. If the electric motor has been removed, it should be fitted in the cover of the oil tank. Fit the drive pin of the electric motor in the drive shaft and re-fit the cover.
NOTE. Make sure the gasket is fitted properly.

24. Screw on the dipstick. Note the dipstick seal. Place the filler strainer (24) in position and screw on the filler plug (25).
NOTE! the O-ring.

Beach valve

25. Push the “Beach” valve (13) into its seat underneath the tank with the ball facing the valve housing, see Fig. 29.

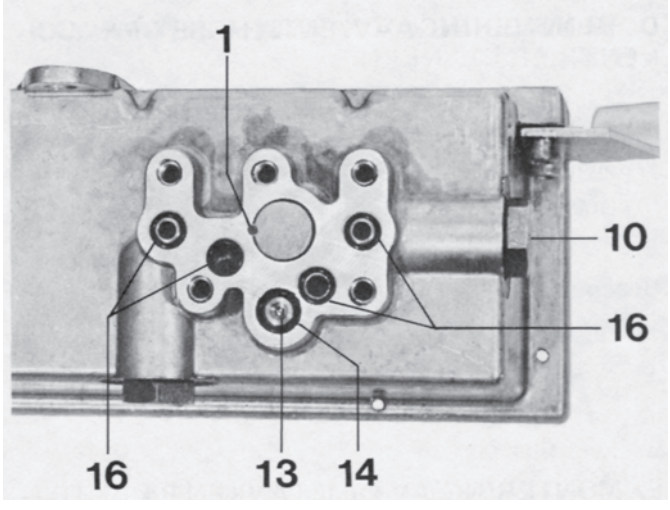


Fig. 29

1. Pump liner lock pin
10. Relief valve
13. ”Beach” valve
14. O-ring, large
16. O-rings, small

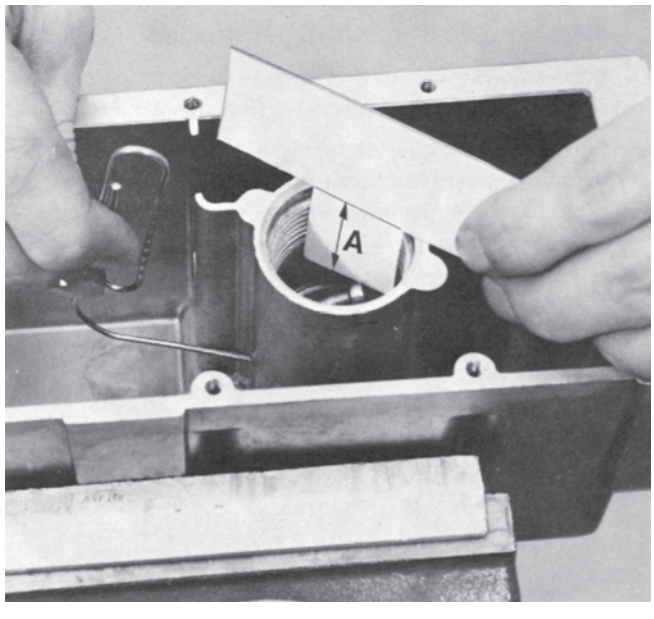


Fig. 30. Gauge for fitting hydraulic piston
A = 25 mm (1")

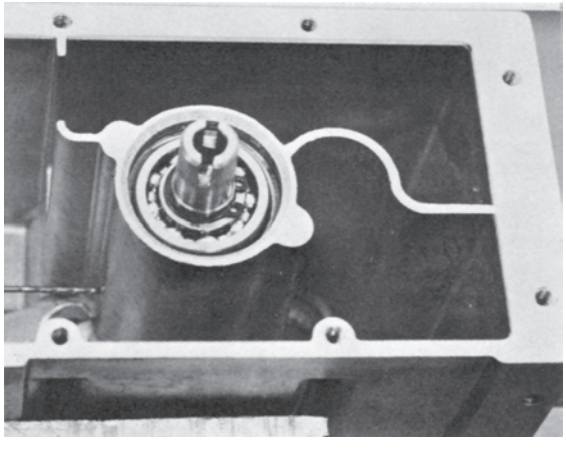


Fig. 31. Drive shaft fitted, not pressed down

D. FITTING THE VALVE HOUSING ON THE TANK

1. Place the five O-rings (14 and 16, Fig. 29) in position. Use new O-rings. Fit the valve housing in under the tank and screw it tight.

Tighten the bolts evenly and in the sequence shown in Fig. 32. Tightening torque 7–11 Nm (5–7 lbft).

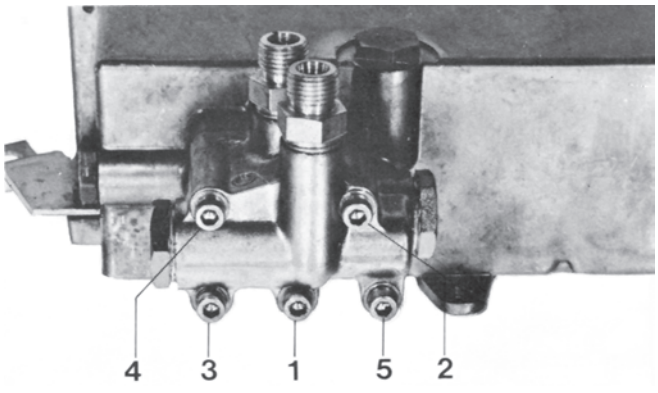


Fig. 32. Tightening sequence for valve housing

E. FITTING THE OIL TANK ON THE TRANSOM

1. Fit the assembled oil tank on the transom and the relay bracket (34, Fig. 33) on the cover of the tank. Connect up the electric cables to the electric motor (1). The cables are marked and should be connected to their respective contacts with corresponding marking

2. Check to make sure there is no dirt, etc., on the hoses and connections for the valve housing. Connect up the hoses (12, 21).

Fill with hydraulic oil (see “Technical Data”) and check the function of the hydraulic pump and for leakage. The system is vented automatically by raising and lowering the drive several times.

The hydraulic pump can be pressure-tested in the same way as for the relief valve, see Part IV, point 5.

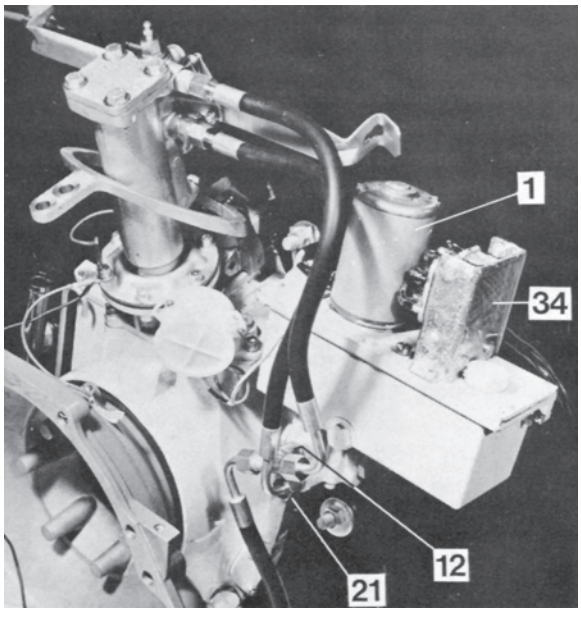


Fig. 33. Fitting the hydraulic tank on the transom

Part VII Reconditioning the lift cylinder

The lift cylinder can be removed with the outboard drive in position.

After removal, clean thoroughly and replace defective components.

If the lift yoke is to be removed, the drive must first be taken off.

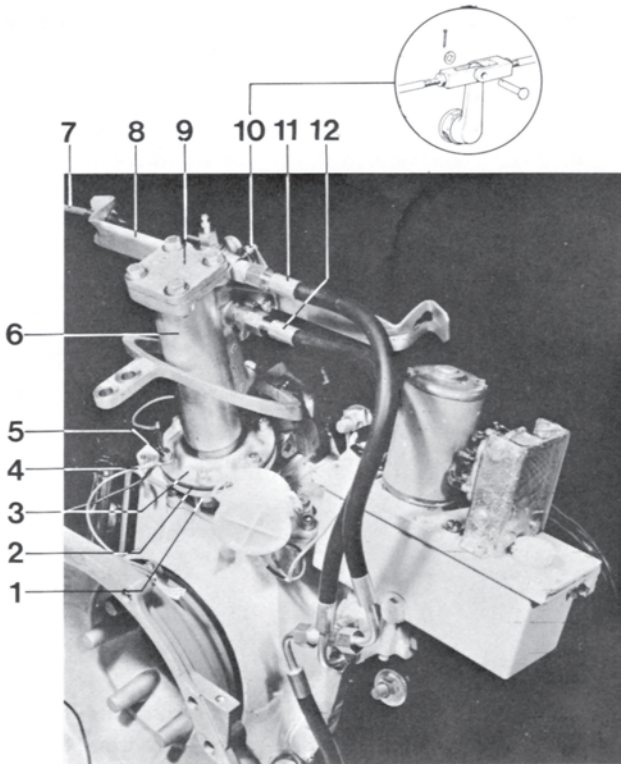


Fig. 34. Removing lift cylinder.

A. REMOVING

1. Disconnect the hydraulic hoses (11 and 12, Fig. 34) and mark them with a tape or similar. Fit plastic plugs as a protection.

2. Remove the control cables from the lever (10) of the control valve and the cable attachment (8) from the lift cylinder (6).
NOTE! With the boat in the water, the control cable with sleeve (7) should be tied up above the waterline to avoid water getting in.

3. Disconnect the ground cables from the lift cylinder's attaching plate (4).

Safety valve

4. Remove the cover (9) on top of the lift cylinder (4 bolts).
NOTE! The O-ring.

5. Unscrew the recessed hex plug and take out the valve parts, spring, stop and ball (a magnetized screwdriver can be used for this).

Lift cylinder

6. Remove the upper part of the piston with the help of tool 884424, see Fig. 35.

7. Remove the cylinder housing from the intermediate piece by unscrewing the six internal hex bolts (5, Fig. 34).
Note the packings between the attaching plate (3), support plate (2) and the intermediate piece (1). The packings between the attaching and support plate also serve as shims for the cylinder housing support bushing.

8. The cylinder housing can now be pulled up from the lift yoke rod.
NOTE! The O-ring (6, Fig. 36) in the lower part of the piston will be damaged when removing and should be replaced with a new one before re-fitting. Then turn the cylinder housing and knock out the piston parts with a brass drift. The piston consists of an upper part (1, steel), an upper support ring (2, plastic), a sealing ring (3, rubber), a lower support ring (4, plastic) and the lower part of the piston (5, steel) together with O-ring (6).

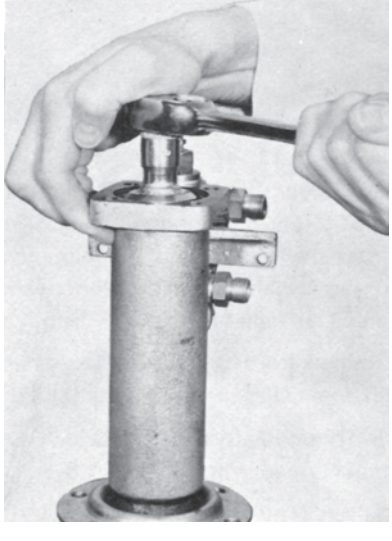


Fig. 35. Removing piston

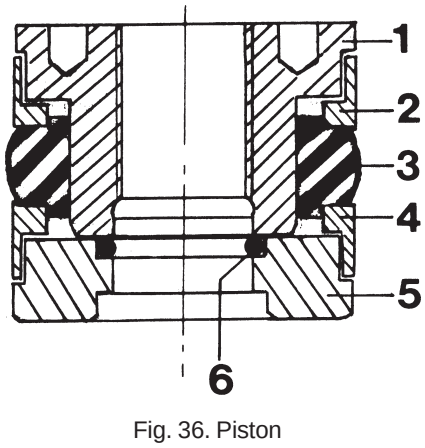


Fig. 36. Piston

9. If necessary, replace both the sealing rings (4 and 8, Fig. 37). Remove the outer seal (8), the circlip (6), the washer (5) and the inner seal (4). If the metal bushing (3) has to be replaced, knock it out with a brass drift.

10. If necessary, the support washer (9) at the lower end of the lift cylinder can be replaced. Place the cylinder housing in a vice with protective jaws and unscrew the support washer.

Control valve

11. When removing the brass nut (22, Fig. 37) the control valve (18) with its two O-rings (19 and 20) will accompany it. A circlip (21) will keep the nut in position at the valve.

Safety release valve

12. Unscrew the plug (15, Fig. 37) with the nipple (17) and the packing (16). Take out the spring (14), the barrel (13) and the ball (12).

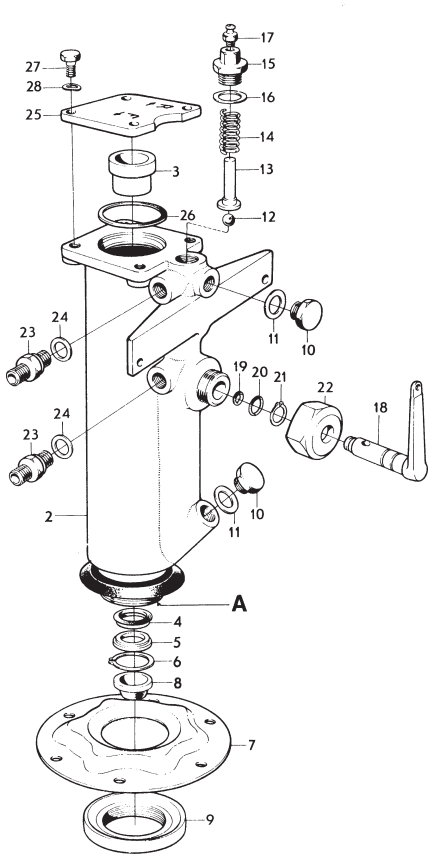


Fig. 37. Lift cylinder
A = Punch pops (two)

Protective bellows

13. Check the protective bellows (for the lift yoke rod) for leakage and cracks. If necessary, replace it with a new one. In order to eliminate the risk of water getting in, in most cases it is necessary to lift the boat ashore or lift its aft a bit.

14. Unscrew the trim indicator and remove the eight bolts (1, Fig. 38) securing the intermediate piece (2) to the mounting collar.

15. Replace the trim indicator in position and carefully lift the intermediate piece with the trim indicator over the yoke rod.

16. The protective bellows are now accessible for replacement. Lift off the upper steel washer (3). Pull the protective bellows (5) off the lift yoke rod and lift off the lower steel washer (4).

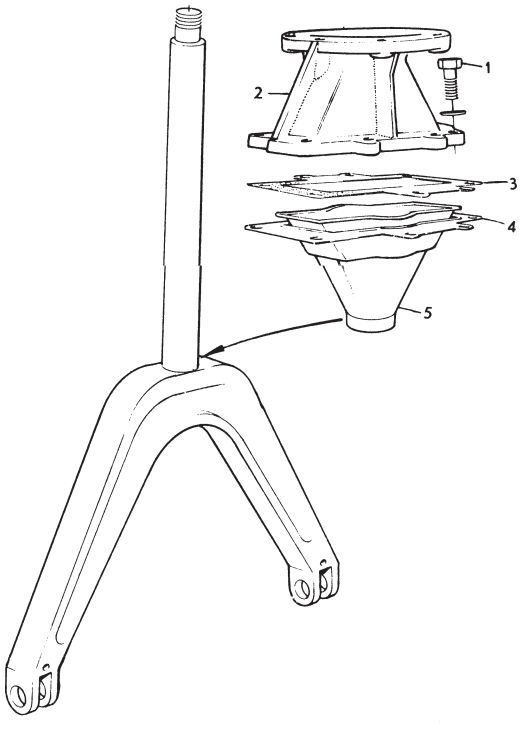


Fig. 38. Lift yoke and protective bellows

Lift yoke

17. If the lift yoke has to be removed, the outboard drive must first be taken off, see Part V.

Then disconnect the trim indicator cable from the port-side leg of the lift yoke. The lift yoke is now loose and can be moved downwards/backwards past the neck of the flywheel casing.
NOTE! The lift yoke can also be removed with the intermediate piece (2) and the protective bellows (5) in position.

B. FITTING

NOTE! Before fitting all parts must be thoroughly cleaned and defective components replaced.

Fitting the protective bellows and lift yoke

1. Coat both sides of the steel washer with a non-drying type of sealing agent. The protective bellows (4, Fig. 39) should be fitted between the two steel washers (2 and 3). Place the steel washer (3) so that the pressed-down edge fits into the corresponding recess in the mounting collar. Fit on the protective bellows so that their cast projection fits into the pressed-down edge of the steel washer, and place the flat steel washer (2) on top. Then fit the intermediate piece (1) and tighten up the eight bolts. Fit the trim indicator. Check when doing this that the sealing for the cable is fitted in the intermediate piece and that the cable runs properly.
2. Fit the lift yoke up through the protective bellows (coat the lift yoke rod with hydraulic oil).
   NOTE! The oil channel (1, Fig. 40) on the lift yoke rod should point towards the drive. Connect up the trim indicator cable to the port-side leg of the lift yoke (with the nut facing aft).
3. Fit the outboard drive. See Part XI.

Assembling the lift cylinder

4. Tap the metal bushing (3, Fig. 41) into the lower part of the lift cylinder (with a metal drift from the top). Place the cylinder housing (with the bottom facing upwards) in a vice with protective jaws. Place the attaching plate (7) over the threaded part of the housing with the dished side facing the cylinder.
   NOTE! Be careful of the dust protector (rubber ring) between the housing and the attaching plate. Then fit the support washer (9). The support washer should be screwed on so far that it is flush with the lower edge of the housing. Thereafter lock with two punch pops on the cylinder housing, “A”, Fig. 41.
5. Press the seal (4) into the bottom of the lift cylinder with the letter side facing inwards.

   Fit the washer (5) with the collar outwards and then put on the circlip (6).

   Press in the seal (8) with its cone facing away from the circlip.

Control valve

6. Assemble the nut (22), valve (18) and circlip (21). Place the two O-rings (19 and 20) in the grooves on the valve (18). Grease the neck of the control valve next to the lever. Push the assembled valve into the cylinder housing and tighten up the nut.

Safety release valve

7. Place in the ball (12). Next place the barrel (13) on the seat of the safety release valve with the plate facing the ball and the spring (14) on top. Fit the plug (15) with the packing (16) and the nipple (17).

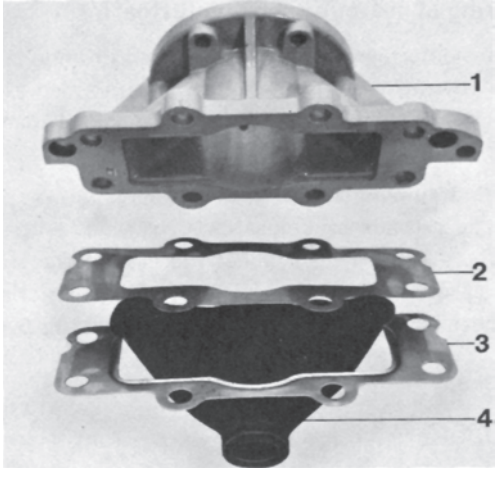


Fig. 39. Protective bellows for lift yoke

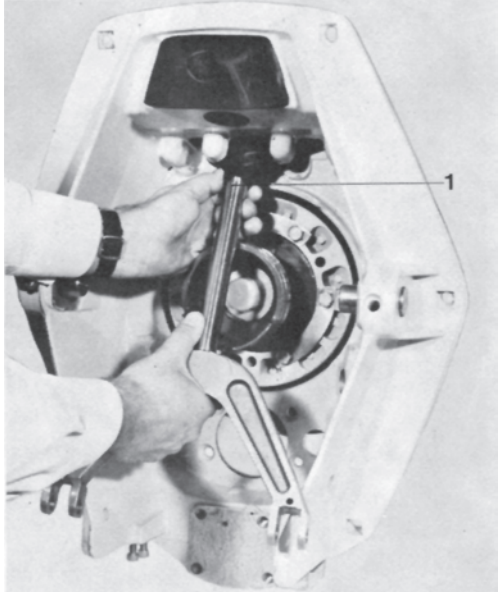


Fig. 40. Fitting lift yoke

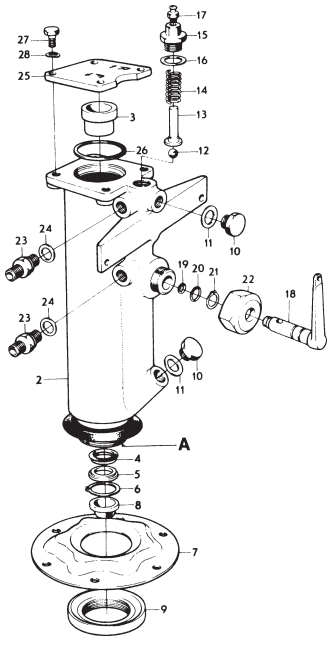


Fig. 41. Lift cylinder
A = Punch pops (two)

Fitting the lift cylinder on the lift yoke

8. When fitting the lift cylinder with the outboard drive removed, the lift yoke must be propped up with, e.g., a wooden prop, between the lift yoke and the neck of the flywheel casing. See Fig. 42.

Apply a non-drying type of sealing agent to both sides of the packings. Then place a packing (1, Fig. 42a) on the intermediate piece. Thereafter place the support plate (2) on the packing, with the convex side facing the intermediate piece, and fit a packing (3) on top of the plate.

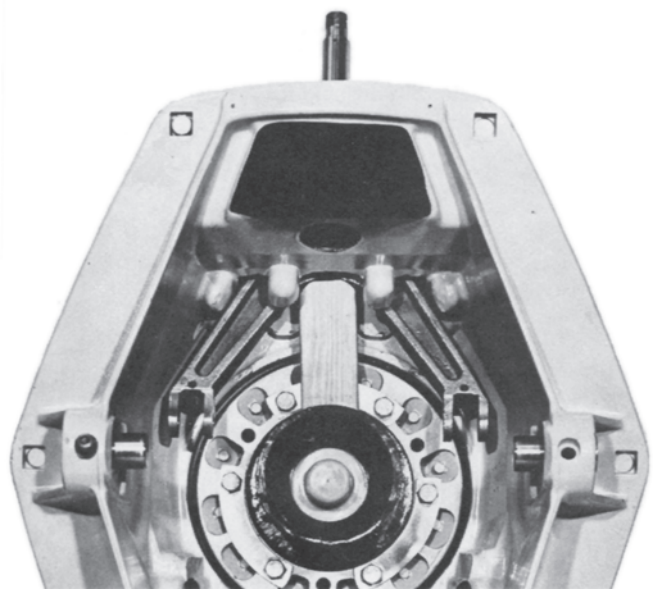


Fig. 42. Propping up the lift yoke

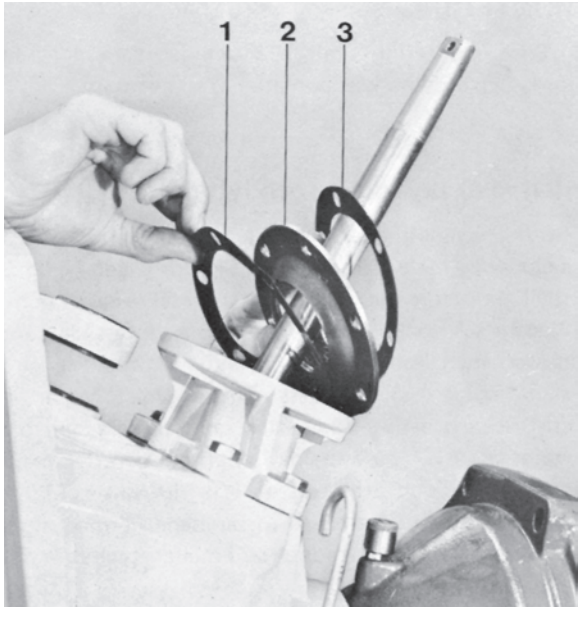


Fig. 42a. Fitting support plate and packings

9. In order to protect the inner seals of the cylinder, drift 884423 should be fitted over the threads at the top (2, Fig. 43) of the lift yoke. Carefully fit the lift cylinder on the lift yoke with the control valve facing aft.

10. Tighten up the attaching plate (1) and the support plate (3) in the intermediate piece (4) with the six bolts. Check the movement of the cylinder housing. It should be possible to turn the cylinder housing without any gap appearing between the metal support and the support plate. If it feels difficult to turn the cylinder housing, it should be adjusted by placing a further packing between the support plate (3) and the attaching plate (1). Apply sealing agent to both sides of the packing.
NOTE! To prevent damage to the seals when removing, the drift should remain over the threads as protection. When final-fitting, connect up the ground cables to one of the attaching bolts (see 4, Fig. 34).

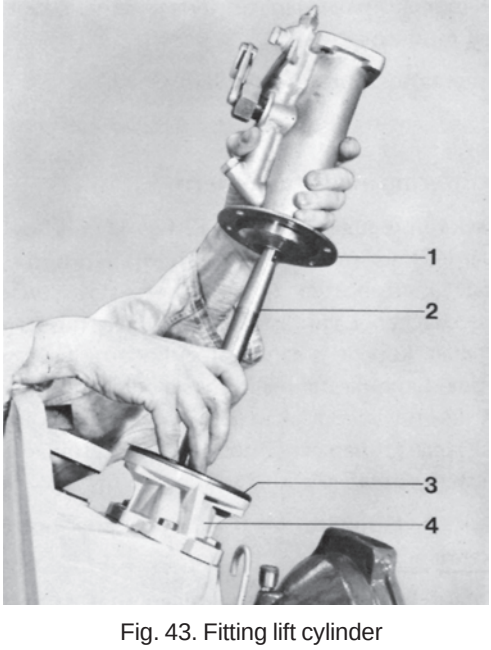


Fig. 43. Fitting lift cylinder

Fitting the hydraulic piston

11. With the large diameter facing downwards, press the piston's lower part (8, Fig. 45) down to the step (9) on the end of the lift yoke rod. Thereafter place the O-ring (7) on top of the lift yoke and carefully push it down with the help of drift 884423 into the groove on the lower part of the piston.

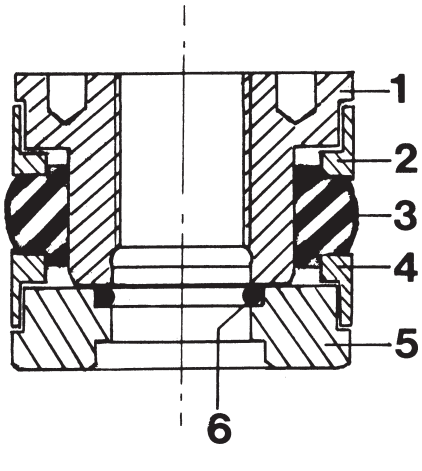


Fig. 44. Hydraulic piston

12. Assemble the other parts of the piston, an upper part (1, Fig. 44), two plastic rings (2 and 4, similar) and a rubber piston ring (3), equilateral. Fit the plastic rings (2 and 4) on the shoulders of the rubber ring (3) and press the ring assembly onto the upper part (1) of the piston.

13. Carefully press down the assembled piston part into the cylinder and tighten up on the lift yoke with the help of tool 884424. The piston should be tightened to a torque of 80–120 Nm (58–87 lbft), see Fig. 35.

Fitting the safety valve

14. Slip the ball (4, Fig. 45) down onto the seat of the valve on top of the lift yoke rod. Then place the barrel (3) with the flat side facing the ball and the spring (2) over the barrel. Screw tight the internal hex plug (1) in the upper part of the piston.

Place the O-ring in the recess on top of the cylinder housing and fit the cover.

15. Fit the cable attachment (8, Fig. 34) on the lift cylinder.

Place the levers of the control valve and the manoeuver control in neutral. The manoeuver cable from the control should be connected to the cable attachment from the port side with regard to the AQ170 and from the starboard side with respect to the AQ130.

Connect the hydraulic hoses to the lift cylinder and the valve housing.
NOTE! Check carefully that no impurities get into the hydraulic system during the fitting. For correct location of the hydraulic hoses, see Fig. 34.

16. The function of the hydraulic system can now be checked providing that the trim cylinder is without fault.

See Part VIII, “Reconditioning the trim cylinder”, and Part IV, point 5 “Pressure check”.

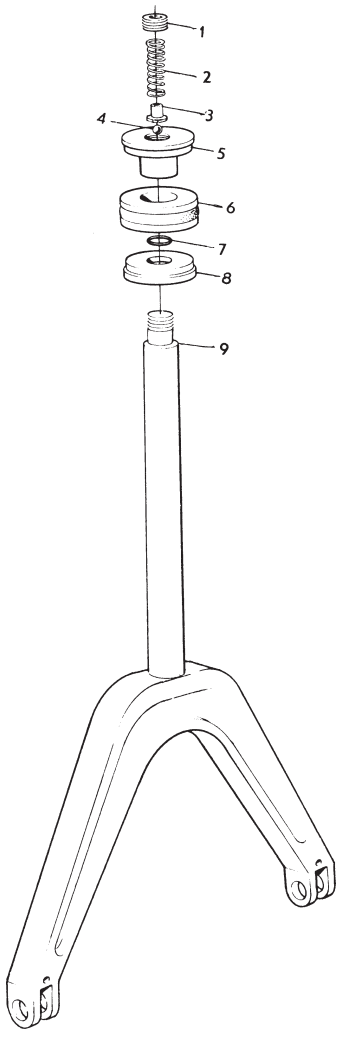


Fig. 45. Lift yoke

Part VIII Reconditioning the trim cylinder

The trim cylinder can be removed with the drive in position.

A. Removing

1. Unscrew the four bolts (1, Fig. 46). The bolts are accessible by swinging the drive to starboard and port side respectively. Press the drive out somewhat and lift off the trim cylinder. **Note** the two O-rings.

2. Slacken the two hose clamps (1 and 3, Fig. 47) for the rubber bellows (2) and remove the bellows.

3. Press the piston (4) out of the cylinder housing (5), using a rubber mallet if necessary, and remove the support ring and the sealing ring (6 and 7) from the piston.

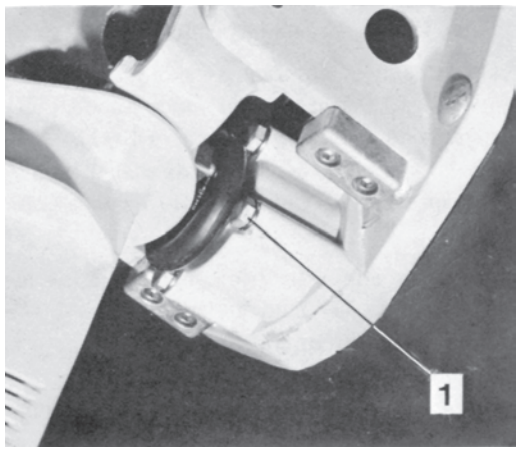


Fig. 46. Removing trim cylinder

4. Inspect the parts of the trim cylinder for any damage that may cause leakage. Damaged parts should be replaced.

B. Fitting

1. Fit the rubber bellows (10, Fig. 48) with the hose clamp (9) on the cylinder housing (6). Fit the sealing projection on the bellows into the groove in the housing and tighten up the clamp.
2. Fit the support ring (2, plastic) and the sealing ring (1, rubber) on the piston (3). The support ring should be placed nearest the piston rod.

   Coat the cylinder and piston rings with hydraulic oil, as this makes pressing in easier.
3. Hold the sealing ring pressed against the support ring and place the piston in the cylinder so far that it goes against the sealing ring (see Fig. 49). With the hand knock on the piston (use a rubber mallet if necessary) and the sealing ring should glide with the piston into the cylinder.

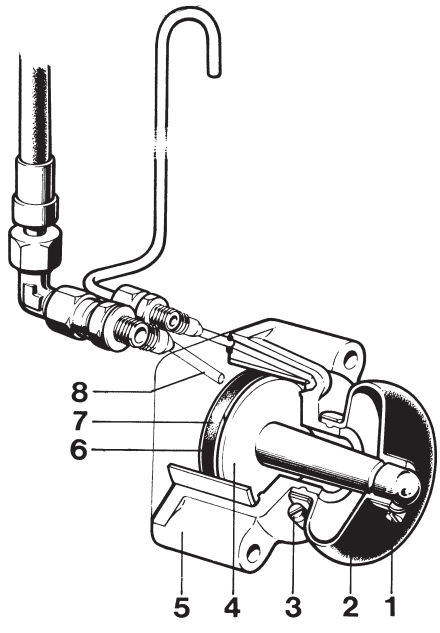


Fig. 47. Trim cylinder with connection

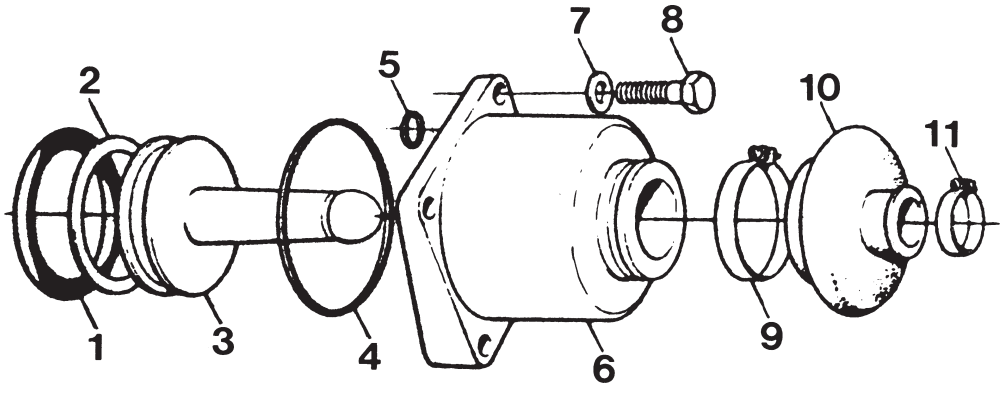


Fig. 48. Trim cylinder

4. Fit the sealing projection on the rubber bellows into the groove on the piston rod and tighten up the clamp (11, Fig. 48).
5. Clean the contact surface on the mounting collar and the trim cylinder. Then apply Permatex or similar. Place the two O-rings (4 and 5) in their grooves. Note that no sealing agent may be applied to the O-rings or their grooves as in this particular case it can impair the sealing capacity of the O-rings.
6. Fit the assembled trim cylinder onto the mounting collar and tighten up the bolts (8) to a torque of 30–50 Nm (22–35 lbft). Note the washers (7). Check to make sure no impurities get into the cylinder.

   Check the oil level in the tank and fill with hydraulic oil if necessary. See under “Technical Data”. Test-run and check the function and sealing of the trim cylinder.

Fig. 49. Fitting piston in trim cylinder

Part IX Replacing the trim cylinder sender and cable

Replacing sender only

If the sender is faulty, it should be replaced complete. Replacement can be carried out with the outboard drive in position according to points 2, 3, 4 and 6 below. Before fitting the sender on the intermediate piece check that the cable runs easily (raise and lower the sender with the cable stretched). Adjust if necessary. Then fit the sender in position and tighten up the internal hex bolt (1, Fig. 51).

Replacing cable only

When replacing only the cable, the steering yoke and steering casing must be removed from the mounting collar as follows:

1. Remove the lock bolt for the steering arm from inside the transom, also the center bolt for the steering casing. See Fig. 22.
2. Pull down and lift off the steering yoke together with the steering casing.
3. Remove the split pin bolts holding the lift yoke and suspension yoke together.
4. Lift up the drive and prop up underneath.
5. Disconnect the cable from the lift yoke (1, Fig. 50).
   NOTE! The sleeve (2, Fig. 51) on the screw.
6. Disconnect the electric cables from the sender and mark them. Unscrew the internal hex bolt (1) securing the sender to the intermediate piece and lift up the sender. Poke up the seal out through the hole in the intermediate piece and remove the sender. If the seal is damaged, it should be replaced.
7. Remove the sender cover and separate the halves as shown in Fig. 52. Remove the cable.
8. Insert the new cable in the cover (if the hole is too small, drill it wider) and place the cable in the slot round the spring as shown in Fig. 52. Place the halves together and screw tight the cover (the lugs A should coincide).
9. Check to make sure that the cable runs easily. Press the cable (the eyelet) carefully through the seal and move the seal down into the recess in the intermediate piece.
   NOTE! In cases of water leakage, a special washer should be fitted under the rubber seal.
10. Connect up the electric cables to the trim indicator, yellow/green to terminal “G” and blue to terminal “–” (minus).
11. Fit the sender in position and screw tight the internal hex bolt (1, Fig. 51). Pull down the cable and then feel that the spring bolt pulls it up again. Secure the cable between the sleeve and the bolt head (2) on the port-side leg of the lift yoke.
12. Tip down the drive and assemble the lift yoke and the suspension yoke with the split pin bolts. See Fig. 56. Then fit the steering yoke and steering casing in the collar. See Fig. 57.
13. Concerning adjustment of the trim indicator, see Part X.

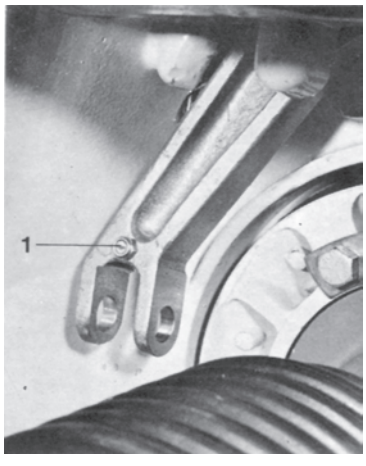


Fig. 50. Cable attachment to lift yoke’s port-side leg

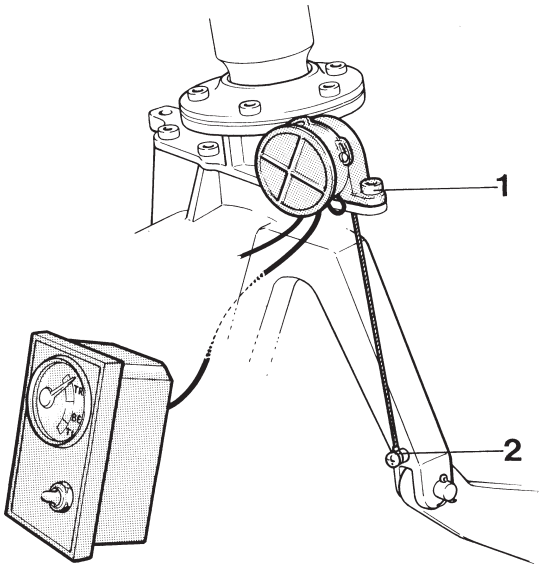


Fig. 51. Trim indicator sender and cable

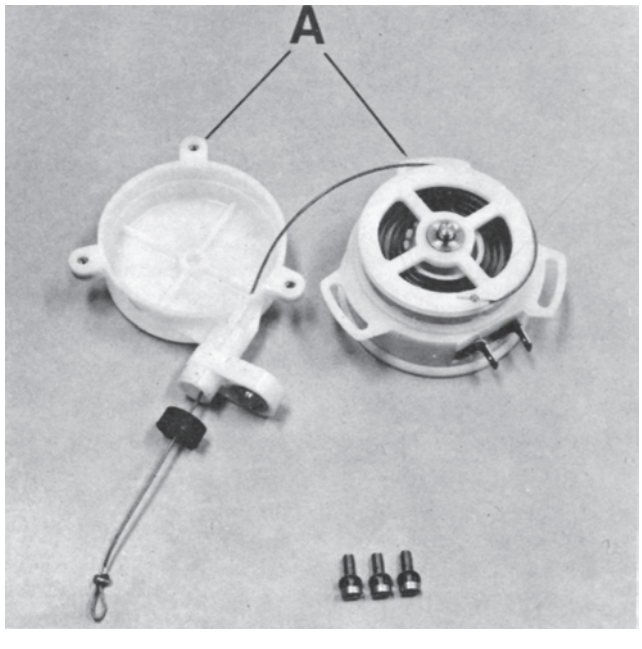


Fig. 52. Sender removed

Part X Adjusting the trim indicator

If the marking on the trim indicator does not coincide with the corresponding position of the drive, the following adjustment can be carried out:

1. Run out the drive so far that the trim piston rod is in the outer position.
2. Slacken the three slotted screws (1, Fig. 53) on the sender so that the cover can be turned.
3. Turn the cover on the sender until the pointer of the trim indicator points precisely between “Trim” and “Beach”. Fix the sender cover in this position by means of the three slotted screws.

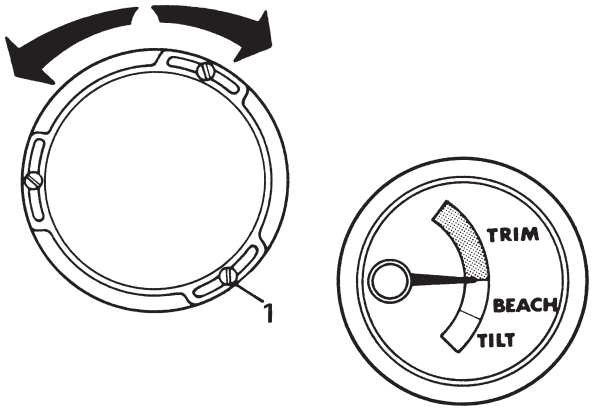


Fig. 53. Adjusting trim indicator

XI Fitting the outboard drive

1. Fit the combined plastic bushings and the wear washers (1) on the suspension yoke (2), see Fig. 54. Dip the shaft pins (3) in molykote or oil and press them a bit into the mounting collar.
2. Lift the drive forward to the mounting collar and prop up under the tab so that it comes to the correct height.

   Push the control cable (4) so far into the drive that the lock plate (5) can lock in the cable groove, and tighten up the lock plate to the front of the intermediate housing.
3. Hang the hose clamp for the universal joint rubber bellows on the neck of the gear housing. Move the drive forwards towards the drive shaft while turning the universal joint at the same time so that the splines of the drive shaft can glide into the corresponding recesses in the joint. Little guidance with the universal joint will make it easy to find the correct position.
4. Move the drive suspension yoke into the mounting collar and line up so that the shaft pins come opposite the holes in the yoke. Press the shaft pins into the yoke. Then turn the shaft pins with the help of a screwdriver so that the lock grooves coincide with the holes of the lock bolts (6) in the ears of the mounting collar. Dip the lock bolts in oil, fit them and tighten up.
   NOTE! the washers under the bolt heads.
5. Fit the bellows for the universal joint on the neck of the upper gear housing. Check carefully to make sure that the bellows are properly fitted. Fit the hose clamp on the bellows and tighten up with the tightening screw on the bottom side of the bellows, see Fig. 55.

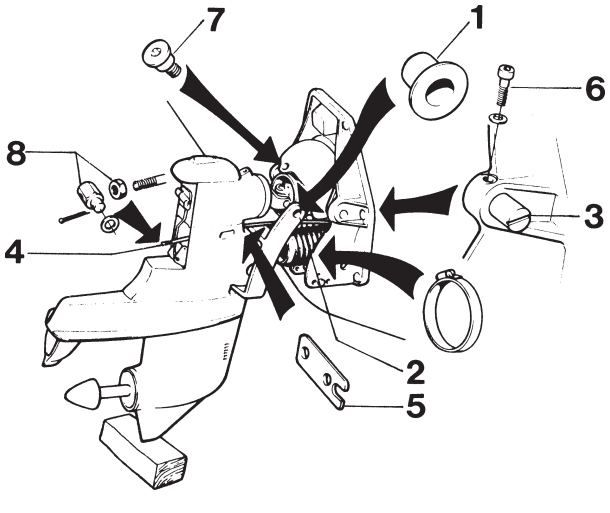


Fig. 54. Fitting outboard drive

6. Raise the drive with the help of the hydraulic lift (or by hand before the lift yoke is connected). Hang on the hose clamps for the cooling water hose and the exhaust bellows and connect them. It should be possible to turn the hose clamps so that the tightening screws are in the position shown in Fig. 55. Turn the drive to full positions and check that the tightening screws do not make contact either with the drive, mounting collar, bellows or control cable. If necessary, adjust and let down the drive.
7. Fit the lift yoke together with the lift ears of the suspension yoke. If possible, adjust the location of the lift yoke with the help of the hydraulic lift. The lock pins should be fitted so that their hex heads face each other. The pins are locked with their split pins. See Fig. 56.
NOTE! Do not forget the washers under the split pins.
8. Fit the assembled steering casing and steering yoke (the flat surface facing forwards) in the mounting collar. When fitting, guide the steering rod so that it is in line with the direction of the drive. The splined shaft of the yoke should be pushed up so far into the mounting collar that the bevel for its upper surface is flush with the plastic bushing (1, Fig. 57). Tighten up the lock screw for the steering rod (2).
9. Lower the steering casing into the steering yoke and tighten it securely with the center bolt for the upper gear housing. See 7, Fig. 54. The tightening torque is 70–80 Nm (50–57 psi).
10. Check to make sure that the control lever and the drive shift lever are in neutral. The drive shift lever is in neutral when it is in the horizontal position.
11. In order to get an idea of possible play in the cable, it should first be pushed in and then pulled back in the sleeve. Then push back the cable a distance corresponding to half the play. Screw the locknut and cube (8) on the shift cable (4) so far that the cube can be fitted in the yoke without squeezing it in its journalling when the shift cable is in this position.
12. Connect up the control cables for the control valve lever, see Fig. 58, and adjust if necessary so that the gear positions are correct when manoeuvering. Fit the casing over the shift mechanism.

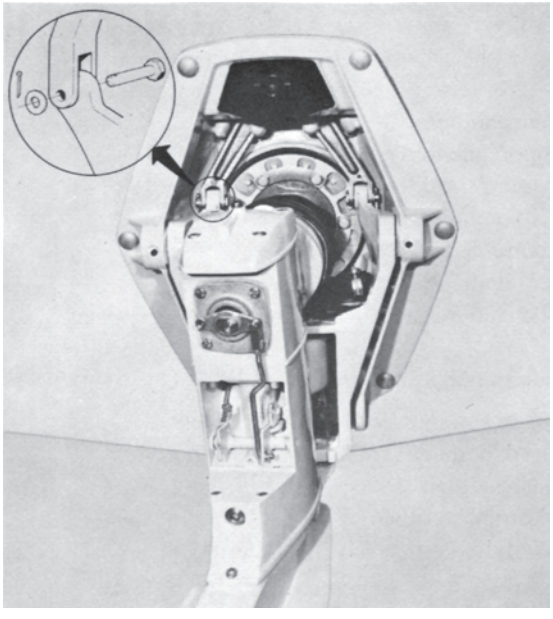


Fig. 56. Connection of lift yoke to suspension yoke

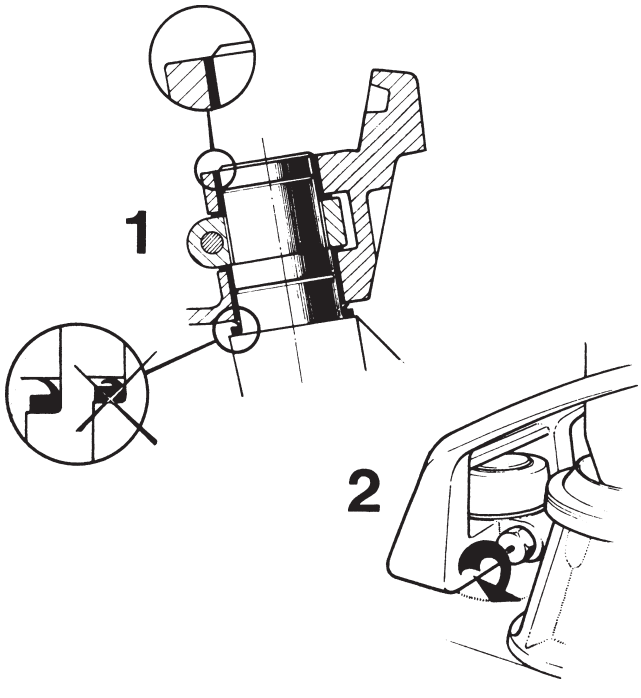


Fig. 57. Fitting steering yoke

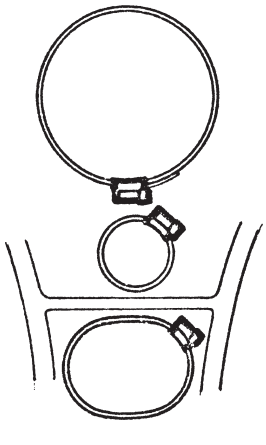


Fig. 55. Correct position for hose clamps

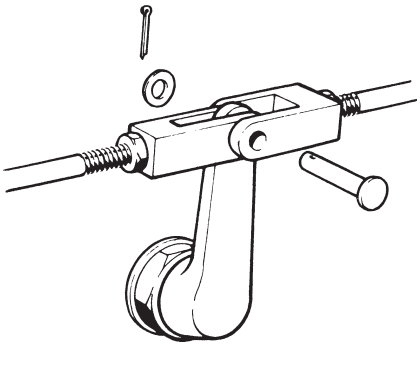


Fig. 58. Connecting up control cables

Part XII Specifications

Type designation	Aquamatic 270T
Tip-up angles	
Trim position, trim plate standard	–4° – +4°
Trim position, trim plate oversize	0° – +8°
Beach position	4° resp. 8° – 30°
Tilt position	30° – 60°
Lifting time from minimum to maximum drive angle, max., approx.	25 seconds

Opening pressure of valves

Relief valve for lift pressure	63.5–89.0 kp/cm^2 (903–1265 psi)
Relief valve for lowering pressure	36.5–54.5 kp/cm^2 (519–775 psi)
Beach valve	130–150 kp/cm^2 (1849–2133 psi)
Safety release valve	80–100 kp/cm^2 (1138–1422 psi)
Safety valve (in lift cylinder)	280–320 kp/cm^2 (3982–4550 psi)

Oil for the hydraulic system

Oil quality	Automatic Transmission Fluid, Type F, A[1)] or Dexron[1)]
Oil capacity, approx.	1.5 dm^3 (1.5 liters)/(1 1/2 US qts.)

Tightening torques	Nm	Kpm	Lbft
Locknut for hydraulic pump liner	5	0.5	3.5
Attaching bolts for valve housing	7–11	0.7–1.1	5–8
Hydraulic piston in lift cylinder	80–120	8–12	58–87
Attaching bolts for trim cylinder	30–50	3–5	22–35
Steering casing center bolt	70–80	7–8	50–58

[1)] Only if type F is not available

New measurements units

For some time past, technicians have endeavoured to find an internationally standardized measuring system. In 1960, such a system was established and was called SI (Système International d'Unités). To a large extent, it is based on the earlier system, but the units are now uniform, that is, no conversions are necessary. The SI-system is now being used within the European industry. The new SI-units are introduced in this "Technical Data". The earlier units, however, are given in brackets.

The new units are:

Output, indicated in kW (kilowatt)
previous unit hp (horsepower)

Torque is indicated in Nm (Newtonmeter)
earlier unit kpm (kilopondmeter)

Speed is indicated in r/s (revs per second)
earlier unit r/m (revs per minute)

Volume is indicated in dm^3 (cubic decimeter)
earlier unit l (liter)

Wiring diagram for drive 270T

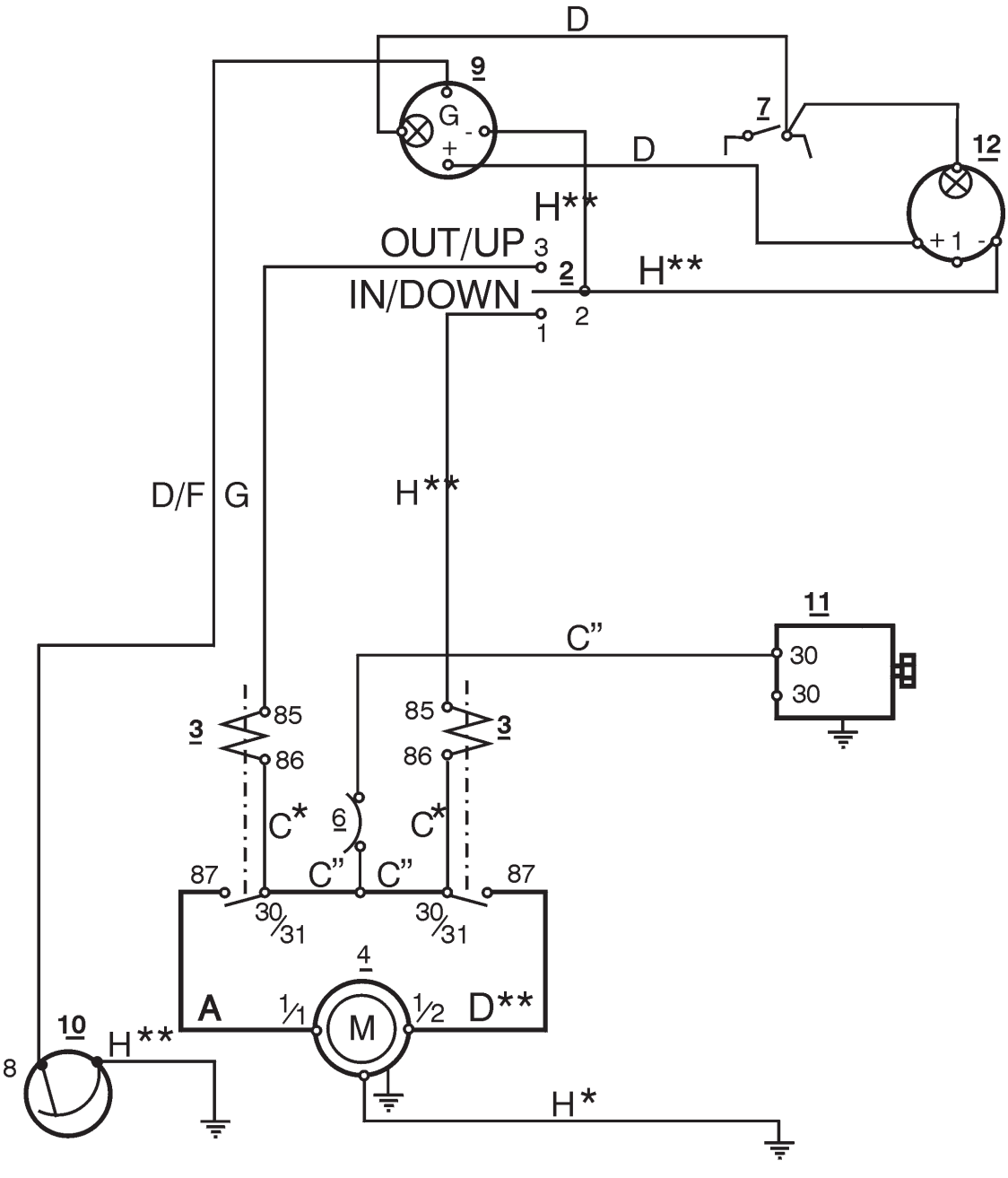


Fig. 59. Wiring diagram

COMPONENTS

1. Key switch
2. Switch
3. Relay
4. Electric motor
6. Motor cut-out
7. Switch
9. Trim indicator
10. Trim indicator sender
11. Starter motor
12. Revolution counter

CABLE MARKINGS

Mark	Colour	sq mm	AWG
A	Ivory	6.0	9
C”	Red (+)	1.5	15
C*	Red	6.0	9
D	Green	1.5	15
D**	Green	6.0	9
F	Yellow	1.5	15
G	Brown	1.5	15
H*	Blue	6.0	9
H**	Blue	1.5	15

Part XIII Special tools

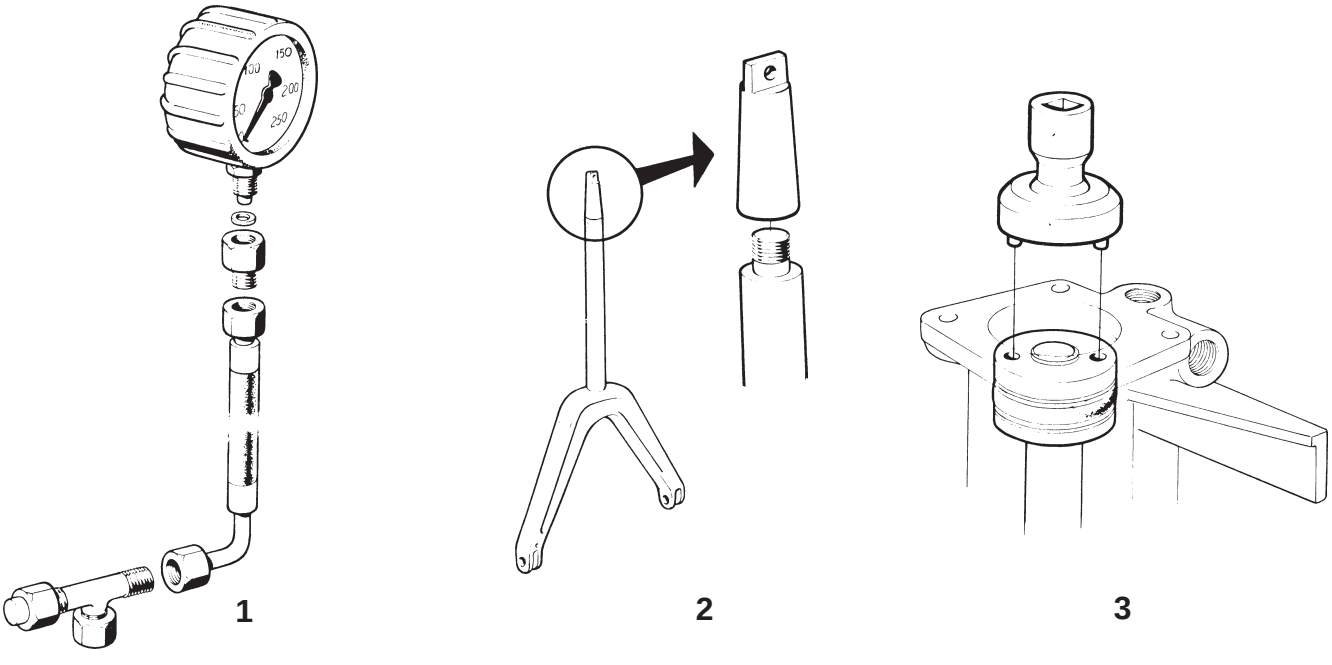


Fig. 60

Pos.	Part No.	Use
1	884418	Pressure gauge for pressure-testing hydraulic system
2	884423	Drift for fitting lift cylinder on lift yoke
3	884424	Torque wrench for removing and fitting hydraulic piston in lift cylinder

Note

Note

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